A UNITED STATES DEPARTMENT OF COMMERCE PUBLICATION

MARINERS WEATHER Log

VOLUME 17, NUMBER 1

JANUARY 1973

71
519

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

DEPARTMENT OF COMMERCE
PETER G. PETERSON, SECRETARY

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ROBERT M. WHITE, ADMINISTRATOR

ENVIRONMENTAL DATA SERVICE
THOMAS S. AUSTIN, DIRECTOR

MARINERS WEATHER LOG

ELWYN E. WILSON,
EDITOR

JANUARY 1973
VOLUME 17, NUMBER 1
WASHINGTON, D.C.

Cover: Dangerous frolicking off Revere Beach, Mass., during Carrie. The tropical storm provided an opportunity for surf lovers and sightseers along the New England coast. Fortunately, unlike sightseers in past years, no one drowned. For a description of tropical storm Carrie, see page 12. United Press International Photo.

ARTICLES
1 Use of ocean temperature while coasting between the Straits of Florida and Cape Hatteras
4 Weather and Olympic sailing
6 North Atlantic tropical cyclones, 1972
15 The 1971-72 Great Lakes ice season

HINTS TO THE OBSERVER
17 Nonuniform visibility

TIPS TO THE RADIO OFFICER
18 Marine weather broadcasts by new Coast Guard radio station at Pt. Reyes, Calif.
18 Publication Weather Service for Merchant Shipping
18 National Weather Service marine weather warnings to be broadcast by Naval Radio Station NBA, Balboa, Canal Zone
18 Corrections to publication U.S. and Foreign Coastal Radio Stations Accepting Ships Weather Observation Messages
18 Note of appreciation to radio officers

ON THE EDITOR'S DESK
19 National Weather Service announces change in marine storm warnings
19 October hurricane clobbers Fiji
20 Buoy drifts from South Carolina to Scotland
20 September-October Erie water levels break 100-yr record
20 Ocean currents being observed by satellite-tracked buoys
21 Letters to the Editor, Special weather report from the PETER REISS
MV SONETTE rides out typhoon Helen in Nagoya Harbor

MARINE WEATHER REVIEW
23 Smooth Log, North Atlantic Weather, July and August 1972
26 Smooth Log, North Pacific Weather, July and August 1972
34 Principal tracks of centers of cyclones at sea level, North Atlantic, July 1972
35 Principal tracks of centers of cyclones at sea level, North Atlantic, August 1972
36 Principal tracks of centers of cyclones at sea level, North Pacific, July 1972
37 Principal tracks of centers of cyclones at sea level, North Pacific, August 1972
38 U.S. Ocean Station Vessel Climatological Data, North Atlantic, July and August 1972
42 Selected Gale Observations, North Atlantic, July and August 1972
43 U.S. Ocean Staton Vessel Climatological Data, North Pacific, July and August 1972
44 Selected Gale Observations, North Pacific, July and August 1972
45 Rough Log, North Atlantic Weather, October and November 1972
51 Rough Log, North Pacific Weather, October and November 1972

MARINE WEATHER DIARY
58 North Atlantic, January
58 North Pacific, January
59 North Atlantic, February
60 North Pacific, February

Routing
Master
Observing Officers
Radio Officer

PARTICIPATE IN AMVER

PLEASE PASS THIS ISSUE ALONG

The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1973.

Copies available to persons or agencies with a marine interest from the Environmental Data Service, Page Bldg. 2 (D54), 3300 Whitehaven St., Washington, D.C. 20235.

Although the contents have not been copyrighted and may be reprinted freely, reference to source is appreciated.

MARINERS WEATHER Log

USE OF OCEAN TEMPERATURE WHILE COASTING BETWEEN THE STRAITS OF FLORIDA AND CAPE HATTERAS

David J. Pashinski
and
George A. Maul
Environmental Research Laboratories, NOAA
Miami, Fla.

Throughout history seafarers have had a need for familiarity with ocean currents. Beyond exploration, a knowledge of the currents is vital to the safe and expedient transport of the mariner's cargo. An early official recognition of the importance of knowing the currents came in 1769 when Benjamin Franklin commissioned the printing of the first chart, with the location of the Gulf Stream, to assist the mail packets sailing between England and the Americas (fig. 1). A. D. Bache in 1860, when superintendent of the

Figure 1.--Chart of the Gulf Stream commissioned by Benjamin Franklin when Postmaster General of the American Colonies. The current's existence was noted by Ponce de Leon in 1513 and charts of the feature date back to 1678. English seafarers during colonial times were not aware of the Stream and refused to listen to the advice of American fishermen who took pains to avoid it. This chart confirms the layman's view that the Gulf Stream is a warm river in the sea. Physically, it is a flow along an inclined front separating cold and warm water masses. (See figure 2.)

Coast Survey (which was charged with delimiting all hydrographic features influencing the safety and efficiency of maritime operations) set the tone of future federal investigations of the Stream. He stated, "The Gulf Stream is the great hydrographic feature of the United States coast, and no survey of the coast for the purposes of navigation would be complete without it."

Numerous investigations into the nature of the Gulf Stream have been undertaken by National Oceanic and Atmospheric Administration (NOAA) components and their predecessors, as well as other federal and private groups. Early studies of the Gulf Stream revealed the complexity in the variation of its trajectory. A mean axis, the location of the maximum surface current, was decided upon by 1900 and is still found today on many of the charts of our Atlantic coast. This mean axis is based on the observations of Bartlett in 1880-81 and of Pillsbury from 1885 to 1891. These pioneering and painstaking scientists measured the velocity from anchored vessels. These ships occupied nine transects of the Gulf Stream between the Straits of Florida and Cape Hatteras. In view of modern knowledge about the short-term variability in the location and velocity of the Gulf Stream, the published axis must be accepted for the crude estimate that it is.

A recurring dream of mariners has been that a simple method might be found for identifying and utilizing the maximum surface current of the Gulf Stream to speed their northbound shipping. Conversely, southbound vessels need to know the inshore and offshore limits of the current to economize on their passage. Because the Gulf Stream carries the warm waters of the tropical Atlantic northward, the temperature of the sea water has been sought as the answer to this problem since Benjamin Franklin first suggested its use.

The favor of using temperature as an indicator has waxed and waned many times over the years as our knowledge of the nature of the Gulf Stream has grown. The original suggestion of using surface water temperature has been found to be inadequate to locate the desired main current because, in its meandering, the Stream sheds pockets of warm water from its edges and entrains pockets of cold water. Many of these pockets can exist at any one time and so confuse the seaman hoping to find the heart of the current. Because of these problems the use of surface temperature to locate the Gulf Stream has lain dormant for many years.

In 1965, scientists recognized that the Gulf Stream could be reliably located using temperature, not at the surface, but at 200 m. below the surface. Pathlines of Gulf Stream trajectories between Cape Hatteras and the Grand Banks were made from research ships by towing an electric thermometer at a depth of 200 m. and steering along the 15°C isotherm. The 15°C isotherm at 200 m. was chosen because the maximum surface current tends to be centered above it. Thus these pathlines were surface velocity maximum trajectories. The surface maximum velocity

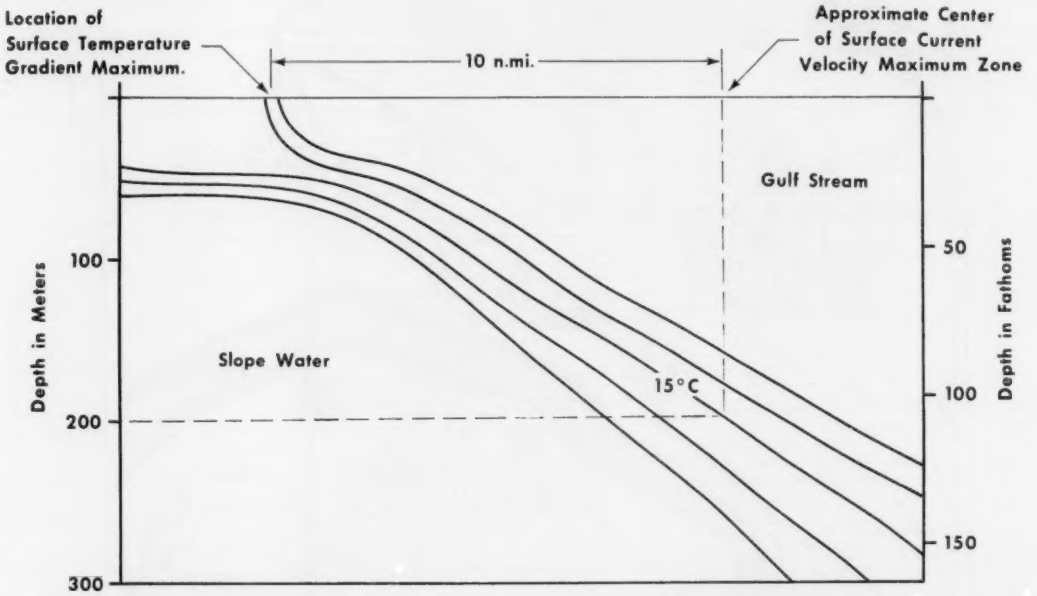

Figure 2.--Schematic temperature cross section of the Gulf Stream; the view is looking downstream, warm water to the right, cool to the left. Other than the 15°C (59°F) isotherm, the values of the lines of constant temperature are arbitrary. The temperature difference at the surface between the Gulf Stream and the slope water ranges from less than 2°C in August to as much as 10°C in March. The horizontal distance between the surface front and the center of the current maximum zone remains fairly constant and appears to be more affected by wind direction than curvature of the stream. The surface temperature change maximum is the boundary feature seen from earth orbiting satellites. (See figure 3.)

zone is about 10 mi wide. Surface current velocities in excess of 2 kt, however, are found over a much broader region which extends approximately 30 to 40 mi seaward from a point several miles on the warm side of the surface temperature change.

Following the indicated isotherm is made easy near the edge of the Gulf Stream because the isotherms are inclined almost 1°, which is very steep oceanographically (fig. 2). The vessel steering along the isotherm will very quickly get an increase in temperature if she should wander too far toward the Sargasso Sea side of the Stream, or a rapid decrease if toward the East Coast.

At first glance, it seems as it the problem of locating or avoiding the Gulf Stream has been solved since relatively economical methods exist for measuring water temperatures at these depths. In fact, attempts to utilize the deep structure in navigating the Gulf Stream were undertaken in 1969. Once again, the complexity of the Gulf Stream was revealed when a large, fairly frequently occurring meander was found between 31.5°N and 33.0°N. On one occasion, the Stream flowed essentially east along latitude 32.5°N to longitude 76.5°W before turning northward to return to the coast. This feature can be understood in light of current theories that take into account the rotation of the earth and the depth of the water.

In these days of rapid ocean commerce, a mariner cannot afford to sail additional miles without a compensating reduction in total transit time. He must know the path and magnitude of the currents that lie before him, so he can best judge the most efficient and safe course for his particular ship with its own speed and handling characteristics. Enough is known about the Gulf Stream to predict a current of at least 3 kt in the surface maximum zone which can represent a boost up to 30 percent for many ships.

Aid in solving this modern statement of an ocean oriented problem is coming from an unlikely source--space. Many meteorological satellites carry infrared scanning devices which yield an image of the heat of the underlying earth. The warm waters of the Gulf Stream stand out nicely in these images (fig. 3), in contrast to the cool shelf waters. This image of the Gulf Stream also shows the meander that frequently occurs off the Carolinas and reveals the value such an image would have to the navigator about to pass through this area. Though the maximum current lies approximately 10 mi offshore of the sharp change from cold to warm water, the resolution of the present infrared scanners is insufficient to reliably locate the surface temperature gradient maximum accurately enough for the mariner. Further, daily coverage is not usually possible because clouds frequently obscure the view of the sea surface. Additional information gained from the deep thermal structure pinpointing the current is required to complement the satellite image.

Figure 3.--Infrared image of the East Coast obtained by the NOAA-1 satellite in Feb. 1971. The cold land masses and cloud tops are white, the warmer coastal waters and slope water are grey, and the warm Gulf Stream is black. Note the eastward flow in the offing of Charleston, S.C. This appears to be a quasi-permanent feature of the stream. The inset shows the surface front (dashed) from this image plotted at the same scale as the mean axis (dotted) determined by Bartlett in the 1880's which still appears on modern charts.

The future holds much promise. Modest equipment now exists to receive Automatic Picture Transmissions (APT) from meteorological satellites by ships at sea. Likewise, similarly modest equipment is available to get temperature at depth. Ships at sea with APT equipment will be able to obtain infrared images, similar to those in figure 3, from the NOAA-2 meteorological satellite launched in October 1972. Thus, there is the prospect that after nearly 200 yr, Benjamin Franklin's ideas of using ocean temperature to guide and assist ships in commerce will have come to full fruition.

WEATHER AND OLYMPIC SAILING

William Bentsen
Associated Colleges of the Midwest
Chicago, Ill.

In the November issue, my report on the U.S. Olympic Trials for Soling class sailboats, held on San Francisco Bay in July, described how important knowledge of wind and current was to us there. Now, happily, I can report that our U.S. Soling team--Bud Melges, skipper; Bill Allen; and myself--were successful in winning Olympic Gold Medals (fig. 4) near Kiel, Germany, in September. Our six-race record, with finishes of 1-2-3-4-1-1, not only gave us a victory in the 23-boat Soling fleet, but gave us the best score among the winners in all of the six Olympic fleets.

Sailing on the "Kieler Bucht" (figs. 5-6), the large body of water north of Kiel and just south of Denmark's middle island, is quite different from San Francisco Bay, and both wind and current were much less predictable. This is not just our amateur judgement--the German organizing committee had a special weather service for all competitors, and many of the teams had their own "met" man--ours did. But none of these experts were really able to give as accurate predictions about wind strength, direction and time of wind shifts, or predictions of current strength and direction. This is no criticism of them; if anyone could predict with complete accuracy what would happen on a specific 2-mi circular area on a wide body of water, with no significant land features anywhere nearby, he would be an amazing person, indeed!

Basically, the weather in that part of the world is almost exclusively the result of "systems" of high and low pressure that move across the northern section of the globe, and within these systems there are smaller oscillations, some of them perhaps covering only a few miles of surface area. It is these very small microsystems that make it so hard to predict what will happen between 1130 and 1400 each day, in a particular place. At least, this was my guess as to the reason for the difficulty.

We did have an 11-yr summary of wind and current data for that area, which the Germans provided. Its chief value was to tell us we should not count on any particular pattern! At noon, the wind could back, or it might veer. It might blow harder, or softer, or remain about the same. The same was true of the current, which was not so much the result of tidal changes, as it was due to wind and rain runoff from all over northern Europe moving toward the Baltic and North Seas. Thus, we went out every day with an open mind, so were never disappointed.

As it turned out, winds were generally lighter than average, although not extremely different from the 11-yr mean for that time of the year. Our windiest race was sailed in about 18 kt at the start, although it decreased during the race. On 2 days, racing had to be cancelled because of insufficient wind. This was quite a change from San Francisco, when our lightest wind speed was around 18 kt.

One other interesting note; the shipping lanes leading to and from the Kiel Canal are some of the world's busiest, and much of this traffic was routed away from the sailing areas. We wondered if the ship traffic had anything to do with the very confused wave patterns that we experienced. We never could make up our minds about this; the water's surface was always quite confused in appearance, regardless of whether any large ships could be seen nearby.

Figure 4.--Bill Bentsen proudly displays the Soling Class Olympic Gold Medal.

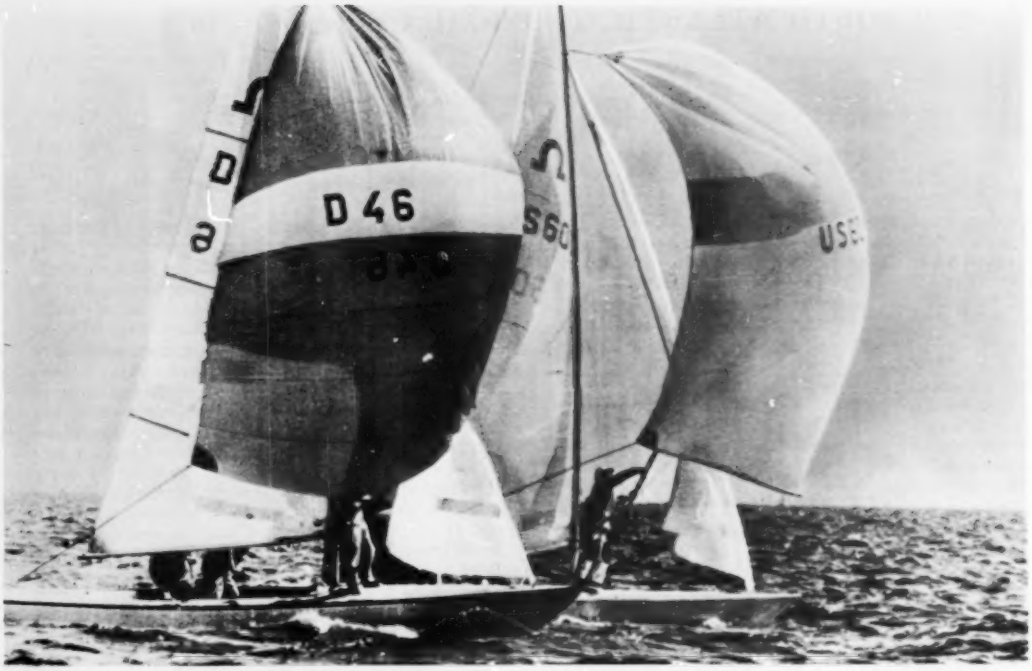

Figure 5. --At a turning mark, the American entry US 600 wins the inside position from the Danish yacht D46. Wind was light. Wide World Photo.

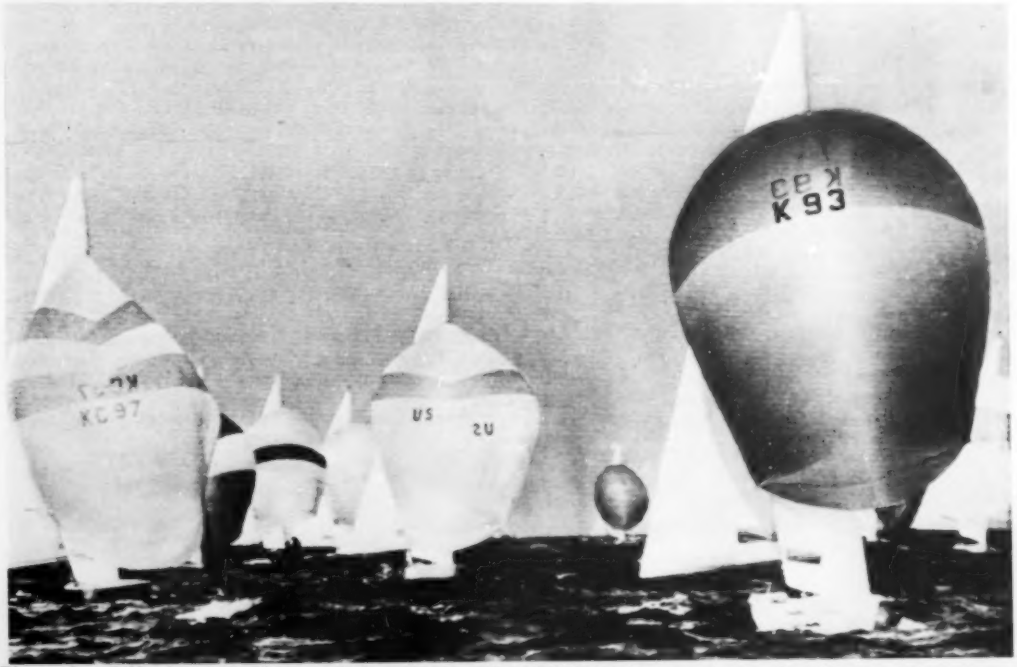

Figure 6. --Billowing spinnakers and choppy seas--The US 600 (center) running on the fifth leg of the course, heads for victory. Wide World Photo.

NORTH ATLANTIC TROPICAL CYCLONES, 1972

Richard M. DeAngelis
Environmental Data Service, NOAA
Washington, D.C.

On only 8 days this year did hurricanes threaten North Atlantic waters with hurricane-force winds. Ship reports indicate no actual encounters with winds of this intensity. There were just four tropical cyclones (fig. 7) in the North Atlantic--the lowest total in the past 30 yr. Three of those storms reached hurricane intensity. Agnes, of little concern to mariners, became the most destructive storm in U.S. history. The last time a tropical cyclone season was so skimpy was in 1930 when just two known storms were reported. The average annual number of tropical cyclones (tropical storms and hurricanes) for the past 30 yr is 10, of which an average of 6 reach hurricane intensity.

There were 121 deaths in the United States this season--117 people died in Agnes and four people died during Carrie. Seven people died in Cuba during Agnes. Total storm damage in the United States was due to Agnes and Carrie. Agnes caused an estimated $3.097 billion; Carrie caused $1.78 million.

Summaries of individual tropical cyclones which reached tropical storm strength including tracks (fig. 8) and table 1 follow. Summaries of extratropical portions of these tropical cyclones if severe can be found in the appropriate Smooth or Rough Log.

HURRICANE AGNES, JUNE 14-22

Hurricane Agnes was responsible for one of the worst natural disasters in U.S. history. Her record-breaking rains caused devastating floods from North Carolina to New York. Hardest hit were Pennsylvania, New York, Virginia, and Maryland. Florida was ravaged by storm tides and tornadoes. U.S. storm damage is currently estimated at just under $3.1 billion. The death toll in the United States is 117. In Cuba, there were seven deaths.

On June 15, a depression developed near Cozumel, off the Yucatan coast. During the next 24 hr, the system intensified and became tropical storm Agnes. Agnes was revealed by satellite to have an unusually large circulation. However, reconnaissance reports indicated a poorly defined eye. On Saturday, the 17th, Agnes began moving northward at about 10 kt. That afternoon, she passed western Cuba. The following morning hurricane force winds were found near her 986-mb center, some 250 mi west of the Florida Keys. Agnes lumbered northward. By Sunday, winds were gusting from 35 to 45 kt, strengthening first in the Keys and by evening as far north as Orlando. Agnes' center was now about 200 mi west of Fort Myers. Maximum sustained winds over land were running 20 to 40 kt. Agnes' large circulation was bringing an easterly to southeasterly flow and showers over Florida. The result was that winds along the east coast were often as strong or stronger than those along the closer west coast. Jacksonville, for example, had the highest gust in Florida at 49 kt early on the 19th, when Agnes was heading for the panhandle. Agnes was a minimum hurricane at best. Over the open Gulf, maximum sustained surface winds reached 75 kt on the 18th. Minimum surface pressure (in the Gulf of Mexico) fell to 978 mb on the 19th. Neither the eye nor the wall cloud ever became fully developed. By the afternoon of the 18th, two things were obvious. Agnes would cross the coast along the Florida Panhandle, and her most destructive blow would be storm tides along the west coast.

On Monday morning, destructive tides hit (fig. 9). At Fort Myers, tides rose 3 ft above normal. A short time later they were 4 to 5 ft above normal in the Tampa-St. Petersburg area. In the afternoon, Cedar Key recorded a tide 7 ft above normal. As Agnes neared the coast, Apalachicola recorded a 6.4-ft tide. Agnes spawned 15 confirmed tornadoes in Florida. They all occurred on the 18th and 19th, and were confined to the peninsula south of Daytona Beach.

Ships in the Gulf of Mexico were hit by minimal gales up to 50 kt between the 17th and 19th. The worst conditions were encountered by the RORIMA at 1200 on the 17th near 22°N, 87°W, the BALTIMORE TRADER at 1200 on the 18th, 130 mi north of Agnes, and the SOCONY VACUUM 6 hr later. In addition to the 50-kt gales, the BALTIMORE TRADER was also blasted by 25-ft seas and 30-ft swells. Visibility around the SOCONY VACUUM was only 200 yd in heavy rain north-northeast of the hurricane near 26°N, 84°W. Thunderstorms were also in that area.

Agnes moved ashore as a tropical storm near

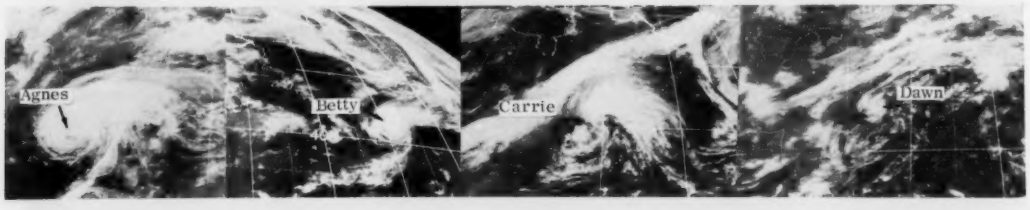

Figure 7.--The North Atlantic four--Agnes (June), Betty (August), Carrie (September), Dawn (September).

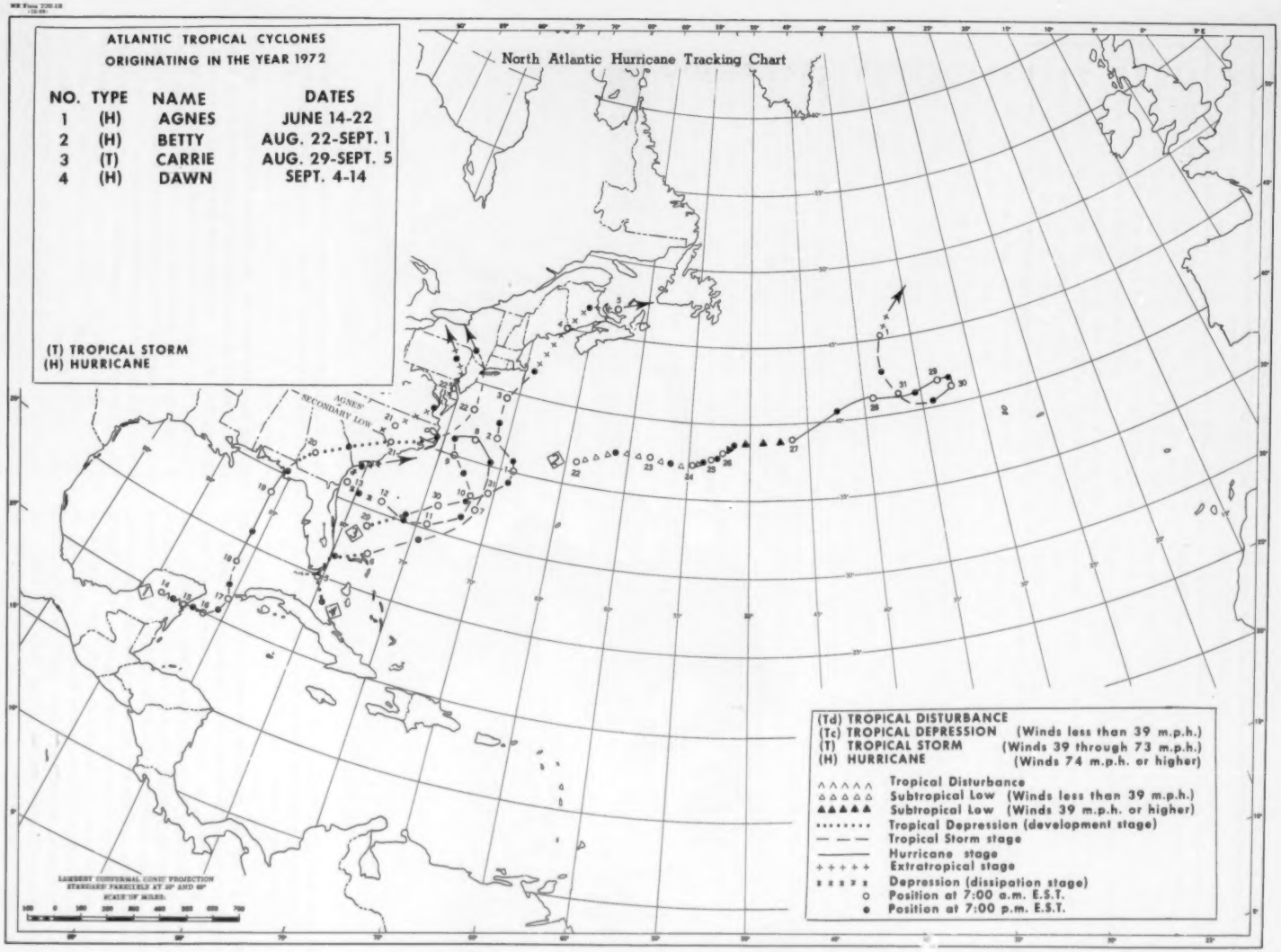
ATLANTIC TROPICAL CYCLONES
ORIGINATING IN THE YEAR 1972
NO. TYPE NAME DATES
1 (H) AGNES JUNE 14-22
2 (H) BETTY AUG. 22-SEPT. 1
3 (T) CARRIE AUG. 29-SEPT. 5
4 (H) DAWN SEPT. 4-14
(T) TROPICAL STORM
(H) HURRICANE
North Atlantic Hurricane Tracking Chart
AGNES' SECONDARY LOW
(Td) TROPICAL DISTURBANCE
(Tc) TROPICAL DEPRESSION (Winds less than 39 m.p.h.)
(T) TROPICAL STORM (Winds 39 through 73 m.p.h.)
(H) HURRICANE (Winds 74 m.p.h. or higher)
Tropical Disturbance
Subtropical Low (Winds less than 39 m.p.h.)
Subtropical Low (Winds 39 m.p.h. or higher)
Tropical Depression (development stage)
Tropical Storm stage
Hurricane stage
Extratropical stage
Depression (dissipation stage)
Position at 7:00 a.m. E.S.T.
Position at 7:00 p.m. E.S.T.

Figure 8. --Tracks of 1972 tropical cyclones.

Table 1.--Summary North Atlantic Tropical Cyclones, 1972

Storm name	Intensity	Date	Coast lines crossed	Highest sustained wind (kt)	Lowest pressure (mb)	U.S. damage	Deaths
1. Agnes	Hurricane	June 14-22	Florida, New York	75	977	3.097 billion	U.S.-117, Cuba-7
2. Betty	Hurricane	August 22-September 1		90	976		
3. Carrie	Tropical storm	August 29-September 5	Maine	60	992	1.78 million	U.S.-4
4. Dawn	Hurricane	September 4-14	Georgia	70	997		

Figure 9.--It's the same old story--Water crushes dreams and cottages so much more effectively than wind. This was particularly true along the low-lying west coast of Florida during Agnes. United Press International Photo.

Panama City late Monday afternoon (19th). She was accompanied by 35- to 40-kt sustained winds and 40- to 45-kt gusts close to her center. Once into Georgia, Agnes weakened to depression stage. During the 20th, the large, weak depression moved northeastward across Georgia and into South Carolina. Cities like Augusta and Macon, close to the storm path, had recorded their strongest winds earlier, while Agnes was still at sea. However, the principal effect was rain. In Georgia, it was heaviest in the south. In the Carolinas, mountain areas were drenched while in the central and coastal areas rain was light. In Georgia, tornadoes were reported near Douglas, in Coffee County, and near Blackshear, in Pierre County, during the afternoon of the 19th. The system moved northeastward across the Carolinas at 12 to 15 kt on Wednesday (21st). The storm intensified as it moved closer to the Atlantic Ocean. Cape Hatteras reported a 32-kt wind with gusts to 54 kt. Agnes reached Norfolk as a rejuvenated tropical storm Wednesday night. It was, however, an unusual system.

At this time, a large extratropical low-pressure system was forming just west of Agnes. On the 22d, surface pressures were below 1000 mb over an area from upstate New York to the North Carolina capes; low pressure was only around 990 mb. Agnes generated an easterly flow of moist ocean air. This, in conjunction with the huge Low, triggered torrential

rains from South Carolina to New York. Many of the river basins in these States were already soaked by heavy June rains.

Agnes moved off the Virginia capes and back out to sea late Wednesday. On the 22d, her lowest recorded pressure was observed (977 mb), before she moved inland near New York City. Coastal winds from Norfolk to Providence ranged from 20 to 40 kt with gusts to 50 kt. Inland heavy rain continued.

Gales were observed over the Atlantic Ocean off the East Coast from the 20th until after Agnes turned extratropical. Ships generally reported higher winds here than over the Gulf. The ATLANTIC PRESTIGE and the MOBIL VIGILANT were particularly hard hit at 1200 on the 22d. Northwesterly 60-kt winds walloped the PRESTIGE near 38.0°N, 74.5°W, and south-southwesterly 55-kt gales and 16-ft seas invaded the VIGILANT near 37°N, 71°W. The THIOS THANASSIS was clubbed by east-southeasterly 45-kt gales off the Georgia coast near 31°N, 80°W, at 0000 on the 20th, and the ESSO LIMA was blasted by 45-kt west-northwesterlies and 16-ft swells near 34°N, 75°W, 48 hr later. Twenty-foot swells and 40-kt winds lashed at the ESSO SAN FRANCISCO as she traveled southwestward down the Florida east coast on the 21st.

Agnes engulfed by the large LOW, which was to the northwest, late on the 22d. This extratropical system refused to die for nearly 2 weeks. After her core changed from warm to cold over southeastern New York on the 22d-23d, her central pressure soared until it hit the 1000-mb mark near Corning, N.Y., during the early hours of the 24th. Extratropical Agnes continued to fill after that, but more slowly. She headed westward for the Buffalo area, looped over southern Ontario on the 25th (her second loop in as much as she had looped over north-central Pennsylvania on the 23d), and then sped east-northeastward across Lake Ontario, northern New York, southern Quebec, Maine, New Brunswick, and Nova Scotia. The extratropical LOW spawned a tornado which tore through Maniwaki, Ontario, early on the 25th. Two persons were killed, and 11 were injured. Five homes and four house trailers were destroyed and the roofs of seven other homes collapsed or were hurled for hundreds of yards by the high winds.

On the Great Lakes, gales on the 22d and 23d were produced by the tight pressure gradient between Agnes and a 1032-mb HIGH moving across James Bay and Quebec. Northerly gales battered ships on southern Lake Huron and southern Lake Michigan on the 22d and early on the 23d. The strongest of these (48 kt) was clocked by the A. H. FERBERT at 0000 on the 23d on Lake Huron near 43.6°N, 82.4°W. The prolonged northerly winds produced 12- to 15-ft waves and extensive erosion along the Lake Huron shoreline in Michigan south of Oscoda and southern Ontario. Breakwalls were destroyed, and some cottages were left partially suspended over the water.

The ZAPHON encountered minimal gales and 20-ft swells near 37°N, 69°W, at 0000 on the 24th, as the storm lost strength over Pennsylvania. Gales were not reported on the 25th and 26th, but picked up again after the LOW reached Cape Breton Island on the 27th. The BALTIMORE, DOBROLUBOV, GUTENFELS, LASH TURKIYE, M. P. GRACE, NATIONAL SEAFARER, SEA WITCH, THALASSA, and USCGC GALLATIN were all struck by 35- to 45-kt gales within the cyclone's eastern or southern quadrants during the last 4 days of June. Gales were not observed near the storm during July.

During the week preceding Agnes, frontal activity brought soaking rains to the mid-Atlantic region. From New England to Virginia, showers and thunderstorms dumped 1- to 3-in. rains with local amounts up to 6 in. In central Pennsylvania, 2- to 3-in. falls were common. Throughout the rest of the State and over central New York, averages were 1 to 3 in. In coastal Connecticut, flooding rains fell on the 18th and 19th; Bridgeport had weekend rains totaling 6 in. Rains in New Jersey averaged 2 to 3 in. Over Maryland, Delaware, and eastern Virginia, totals ranged from 0.5 to 2 in. Local amounts were reported in excess of 4 in. in Virginia and 6 in. in Maryland. Meanwhile, dry weather continued to plague the southeast and was becoming critical in some sections of Georgia, Alabama, and central Florida. The stage was set for Agnes.

Rainfall over Cuba was a harbinger of things to come. Heavy rains drenched the western part of the island for 4 days. Cape San Antonio was deluged with more than 16 in. In one 6-hr period, they received a 9-in. downpour. The Isle of Pines recorded more than 17 in. of rain during the same 4-day span, which ended on the 18th.

Most sections of Florida received 2 to 3 days of soaking rains from Agnes. In the south, it rained from the 17th through the 19th, while in the north most rain fell from the 18th through the 20th. In the Florida Keys, a cloud mass which was to become part of Agnes' circulation started dumping rain late on the 11th. Key West recorded 8.53 in. over a 7-day period. Big Pine Key had 12.69 in. Five to 7 in. of rain fell over most areas east of Tallahassee. Highest totals were 7.87 in. at Naples and 7.17 in. at Talahassee. Light amounts of less than 2 in. were confined to the east coast, south of Vero Beach.

Heaviest rains in the southeast occurred along the eastern slopes of the Blue Ridge Mountains from about Greenville, S.C., to Lake Lure, N.C., northeastward to the Danbury-Reidsville area. Totals ranged from 4 to 10 in. Much of this fell in less than 48 hr from the 19th through the 21st. Mt. Mitchell, N.C., had a storm total of 10.60 in. Major river flooding followed flash flooding of mountain and piedmont streams. Severe flooding occurred on the Yadkin-Pee Dee River system and the Dan River. Lesser flooding occurred along the Catawba, Saluda, Rock, Congaree, Lumber, and Broad Rivers.

Throughout the eastern Carolinas rain was relatively light. East of Charleston-Columbia-Raleigh, totals were generally less than 4 in., while east of Wilmington-Norfolk, Va., totals less than 2 in. were common. Cape Hatteras, recorded a 0.04-in. total. In the mountains west of Asheville, N.C., totals of 2 to 5 in. were common.

Eastern Alabama received 2 to more than 7 in., most of which was welcomed and absorbed. Headland reported a total of 7.67 in. Throughout most of Georgia, 4- to 6-in. totals were common. Most occurred in a 48- to 60-hr period from the 18th to the 21st. East coast amounts were 6 to 9 in. At Brunswick Airport on St. Simons Island, a total of 9 in. was reported; 8 fell in a 24-hr period.

Heavy rains in Virginia produced severe flooding over the James and Appomattox River Basins, and

along the Potomac and many smaller rivers in the north. In the eastern half of the James River Basin and western half of the Appomattox Basin, flooding was the worst in history. Crest stages exceeded those of Camille '69 by several feet and topped high-water records dating back 200 yr.

Pre-Agnes rainfall that aided in the flooding occurred on the afternoon and evenings of the 17th and 18th. Heavy showers dumped up to 3 in. of rain over the upper and central James subbasins. The rain-shield of Agnes reached southern Virginia by the 20th. Heaviest rains fell on Wednesday, the 21st, and into early Thursday. Rains totaling 4 to 10 in. quickly flooded the small streams and tributaries in the upper James Basin and in the central Virginia counties along and east of the Blue Ridge Mountains. Big Meadows had a total of 13.60 in. The average for the whole James Basin was 6.12 in. from the 19th to the 23d. The heavy rainfall, concentrated in the upper portion of the Appomattox Basin above Farmville, averaged 8 in. for the same 4 days.

The James River swamped a 200-block area of downtown Richmond, in what appears to be the worst flood in the city's history. A crest of 36.5 ft occurred at the City Locks on the 23d. This topped the old mark of 30.0 ft set back in 1771.

Heaviest rain in all of Virginia fell in the north. Ten inches or more fell over the counties of Madison, Rappahannock, Culpeper, Fauquier, Prince William, Fairfax, and Loudoun. The highest total was about 16 in. near Chantilly. Nearby Dulles Airport recorded a 13.65-in. total and a maximum 24-hr amount of 11.88 in. Torrential downpours from Wednesday afternoon through Thursday morning were responsible for flash flooding throughout northern Virginia.

In Maryland and the District of Columbia, heavy rains in less than 24 hr, on the 21st and 22d, resulted in severe flooding. Delaware had local flash flooding from the 4 to 6 in. of rain that fell in the northern part of that State. Maryland's heaviest rains occurred in the north-central part of the State where totals set all-time records. Highest total rainfall was 14.68 in. at Westminster and 13.85 in. at Woodstock. Totals of 8 in. or more fell in an area west of Chesapeake Bay and east of Hagerstown. The District of Columbia reported more than 7 in. In Delaware, the maximum reported total was 6.76 in. at Middletown. Flooding was abetted by the short period in which much of this rain fell.

The heavy rains caused disastrous flash flooding of creeks and streams in Maryland, the District of Columbia, and Newcastle County, Del. Major flooding followed. The Potomac, fed by heavy rains over its entire basin, began flooding on the 22d. At Little Falls, just outside Washington, the river crested at 22.0 ft in the early hours of the 24th. Flood stage here is 10.0 ft. Meanwhile at Wisconsin Avenue, downtown Washington, a 14.45-ft crest had occurred and persisted for about 8 hr.

In New Jersey, heavy rains caused extensive flooding. Rains of 1 to 2 in., falling in a 24-hr period on wet ground, caused the Saddle, Ramapo, and Passaic Rivers to overflow their banks on the 22d. Total rainfall in northern New Jersey was 2 to nearly 5 in. Greatest amounts fell in the northwest; Sussex recorded a total of 4.61 in. and Long Valley reported 4.90 in. Crests were generally 1 to 2 feet above flood stage and flooding continued into the 24th. Heaviest rains occurred in southwestern New Jersey, south of Philadelphia, Pa. Twenty-four-hour rainfall averaged 3 to 5 in. over Camden, Gloucester, Salem, and Cumberland Counties. Total storm rainfall ranged up to 6.24 in. at Camden. Flash flooding in these counties caused extensive agricultural damage. The Delaware River was the beneficiary of rains from New York and New Jersey. However, it remained below flood stage.

Connecticut rains were spread out over a 5- to 6-day period, and were heaviest mainly in the western half of the State. Heaviest amounts fell on the 22d, 23d, and 24th and ranged from 0.5 to 2 in. Total storm amounts generally ranged from 2 to 4 in. Saugatuck Reservoir, for example, reported 4.04 in. of rain from the 21st through the 26th.

In Pennsylvania, Agnes' heavy rains fell on wet ground. Runoff was heavy; flooding, disastrous. Torrential rains began Wednesday (21st) and continued through Thursday. Maximum 24-hr totals exceeded 7 in. in a band from north of Williamsport southward through Sunbury, Harrisburg, and York to the Maryland border. Harrisburg had a maximum 24-hr amount of 12.55 in. In extreme western Schuylkill County, a gage at a watershed research site measured 14.5 in. in a 24-hr period. Total storm rainfall averaged 8 to 12 in. throughout the entire central section of the State. In several areas, precipitation went above 12 in. In western Schuylkill County, up to 18.8 in. fell.

Small streams began flooding Wednesday night. Major river flooding followed on Thursday and Friday. Along the main stem of the Susquehanna River, flood levels were 3 to 6 ft above previous marks set in March 1936. Crests were generally 12 to 18 ft above flood stage. At Wilkes-Barre, water crept over the levees early Friday morning. By Saturday evening, the powerful river crested more than 18 ft above flood stage and more than 7 ft above the record flood of 1936. At Harrisburg, where the first floor of the Governor's mansion was underwater, the river crested nearly 16 ft above flood stage. Along the West Branch of the Susquehanna, most of the flooding occurred downstream of Karthaus. Crests ranged 6 to 16 ft above flood stage. In Williamsport, Milton, and Lewisburg, crests topped previous 1936 marks. Records were also set at Loch Haven and Jersey Shore.

In southeastern Pennsylvania, the Schuylkill River, beneficiary of some of Agnes' heaviest rain, reached record or near-record levels. At Berne, Pa., a 19-ft crest topped a 1955 previous high by more than 3 ft. All-time record crests quickly followed downstream at Reading, Pottstown, and Norristown. Sections of Philadelphia were also flooded (fig. 10). Four- to 10-in. rains swelled the Lehigh River to overflowing at Lehighton, Walnutport, Bethlehem, and Allentown.

Flooding occurred along most of the navigable streams in western Pennsylvania. At Pittsburgh, the Ohio River reached its highest crest since 1942. Crests on the Ohio River ranged from 9.3 ft above flood stage at Dam 14, Clarington, Ohio, to 12.1 ft above flood stage at Wellsburg, W. Va. Along the Allegheny River record flooding occurred from Salamanca, N.Y., to above Eldred, Pa.

Shortly before midnight on Tuesday (20th), rains turned heavy in New York's southwestern highlands. Morning reports showed falls of 4 in., 5 in., and 6 in. over the upper reaches of the Chemung River Basin. Runoff caused local flash flooding in Allegany and Steuben Counties. A few hours later, most of

Figure 10.--in a battle of transportation systems, the Schuylkill waterway temporarily encroaches on the highway's and railway's domain near Philadelphia's Pennsylvania Railroad Station. The Evening Bulletin.

New York State was under the Agnes rainshield. Over the Chemung watershed, an average of 3 more in. fell during Wednesday. Runoff from the 2-day rains brought the main rivers to above bankfull stages. By the morning of the 23d, another 3 to 5 in. were added to the river basin.

Before it was over, 10 to 13 in. fell in Allegany and western Steuben Counties. Wellsville had an unofficial total of more than 13 in. At Alfred, 12.9 in. was measured. The 4-day average along the basin was near 9 in. This resulted in highest stages of record all along the Chemung River. During the height of the flood, a 4-mi-long lake was created by the Chemung River between Corning and Elmira. The Allegheny, Genesse, Canesteo, and lower Susquehanna Rivers were also in this heavy rain area. Total rainfall was greater than 6 in. west of Binghamton and south of Rochester. In the Finger Lakes region, from Wyoming County, eastward to Cortland County, totals of 6 to 9 in. were common. Ten inches of rain was measured in the hilly terrain just west of Canadaigua Lake in Ontario County. The inflow of streams into the Finger Lakes produced record high lake levels and severe flooding of shore areas. Three to 5 in. of rain fell over the Chenango River watershed, in south-central New York. Flooding occurred along the river from the 22d to the 24th. Crests were generally 1 to 2 ft above flood stage. Farther south in the Catskills, 4- to 6-in. rainfall totals were common.

Agnes is the costliest hurricane in U.S. history. Total storm damage is now estimated at $3.097 billion. For flooding of this consequence, the storm death toll of 117 is very light. Pennsylvania received more than two-thirds of the damage and had 48 of the deaths.

Outside the United States, Cuba suffered heavily. On the western part of the island, torrential rains caused severe flooding. In Pinar Del Rio, some 97 homes were destroyed and another 300 damaged. There were seven deaths.

Florida suffered nine deaths, 170 injuries, and $8.24 million damage. Damage resulted from tides, winds, and tornadoes, which were devastating to both public and private property. Damage was heavy in Franklin County because of Agnes' storm tides. These tides, highest in many years, destroyed homes and businesses, washed out roads, and cut off access to many offshore islands.

Pinellas County was also hard hit, particularly in the St. Petersburg area. Inland, winds or tornadoes were responsible for the damage and for most of the deaths. At Okeechobee City, a series of windstorms cut a path 100-yd wide through Treasure Island Park, a fishing lodge, and several other mobile home parks. Six people were killed, and 40 injured. Damage, including the destruction of 50 mobile homes, was estimated at $500,000. No deaths were tornado related. Total tornado damage was estimated at just over $4.5 million.

Total storm damage in Georgia was estimated at $205,000. The tornado near Douglas was responsible for $100,000 damage. The Blackshear tornado destroyed a mobile home, and damage was estimated at $5,000. Over the rest of the State, property damage was estimated at $80,000 and crop damage at $20,000. South Carolina damage was also minimal and restricted to flooding. In the Pee Dee Basin, floods caused an estimated $25,000 in crop losses. Total storm damage for South Carolina was about $50,000.

The Yadkin River in North Carolina flooded more than 86,000 acres. Total losses in the Basin were estimated at $4.22 million. Of the losses, more than $3.5 million were agricultural and mainly to growing crops. Street flooding in Elkin, Yadkin College, and other river towns accounted for the remainder. Two deaths occurred in North Carolina. Total North Carolina damage is estimated at $6.56 million.

Flood damage in Virginia has been estimated at $125.99 million. The death toll stands at 13. Destruction was widespread throughout central Virginia. It ranged from agricultural damage on small streams, to inundated towns and cities on the larger rivers. Northern Virginia was particularly hard hit. Fairfax County reported an estimated $25 million damage, by far the largest in the State.

Total storm damage in Maryland and the District of Columbia has been estimated at $110.19 million. There were 21 storm deaths in Maryland, one in Delaware, and none in the District of Columbia. Damage in Delaware was mostly minor. Disaster to the Chesapeake Bay counties was primarily in the form of losses to the shellfish and oyster industry with resultant unemployment. It appears now that the damage to the industry will be less than that attributed to the floods of hurricane Camille in 1969.

An indication of the severity of damage in Pennsylvania is that the whole State has been declared a disaster area. Total storm damage is currently estimated at $2.12 billion. The enormity of this figure can be realized when compared to the total storm damages of hurricanes Betsy (1965) and Camille(1969). In each storm, the total was about $1.4 billion. The floods resulting from Agnes and her extratropical counterpart have caused the worst natural disaster to ever hit Pennsylvania. In addition to the damage, there were 48 deaths. Altogether, some 250,000 people were forced to evacuate their homes. Many returned to find their homes gone. Public water and sewage facilities flooded out many areas. Some towns had to ration water. Fires broke out in many communities where firemen, unable to reach the blaze because of flooding, stood helplessly by. Workcrews of all ages toiled through long, hard hours to clean up what the waters had ravaged. Crop losses were estimated at $120 million.

Damage in Ohio was mainly confined to the southern shore of Lake Erie. Northeasterly winds generated 15-ft waves and caused a 3.5-ft rise in the lake level along the south shore. Damage to houses, cars, boats, buildings, docks, and ships was estimated at $2.00 million.

There was some flooding along the Ohio River from Hannibal to East Liverpool. Powhatan Point was especially hard hit. Total damage in this area is estimated at $1 million.

Total damage in West Virginia was estimated at $7.75 million. Almost all of this occurred along the Ohio River from New Martinsville, W. Va., to Chester. Wheeling was particularly hard hit.

Total damage in New York has been estimated at $702.50 million. The death toll stands at 24. Some 100,000 people had to evacuate their houses. The greatest loss of homes was in the Elmira-Corning area. Other hard hit cities include Salamanca, Olean, Wellsville, and Hornell. The overflow of several Finger Lakes caused damage to boats, docks, marinas, and surrounding properties. Rains and floods caused severe crop damage throughout the southwestern tier and Finger Lake counties.

Total storm damage in New Jersey was estimated at $15 million with one storm fatality. Crop damage contributed $10 million to the total.

In New England, damage from wind and rain was considered minor.

HURRICANE BETTY, AUGUST 22-SEPTEMBER 1

Betty was spawned by a small intense subtropical LOW identified as Bravo. Bravo was first detected near 36.5°N, 64.0°W at 1200 on the 22d. Gale-force winds were reported close to its center, which was moving eastward at about 12 kt. During the next few days, Bravo slowed but continued to intensify. By the 26th, 60-kt winds were reported close to its 992-mb center which was located near 37°N, 52°W. A passing ship, the VALVANUZ, encountered 50-kt winds. The storm turned east-northeastward. On the 27th, a reconnaissance crew reported that despite the northerly latitude, tropical energy processes had become dominant. As a result the LOW had grown in size and strength. The system was redesignated hurricane Betty near 39°N, 46°W. This is the farthest north that a tropical storm has first reached hurricane intensity. Maximum winds of 90 kt blew around the 976-mb center, Betty's forward speed was up to 20 kt, and she remained on an east-northeasterly course until the 29th. By this time, Betty, some 240 mi northwest of the Azores, slowed, turned, and began to drift southwestward. Although winds were still hurricane force, the storm was weakening. On the 30th, the HOEGH TRANSPORTER, some 120 mi north of the storm's center, encountered 40-kt winds in 13-ft seas. Betty completed a clockwise loop on the 31st as a tropical storm. By the 1st of September, she had become extratropical.

TROPICAL STORM CARRIE, AUGUST 29-SEPTEMBER 5

Tropical storm Carrie may have been spawned by a disturbance that moved off the African coast late on the 15th. It wasn't until 2 weeks later, off the east-central Florida coast, that a closed circulation became apparent. By midday on the 31st, recon-

Figure 11.--Surging surf soaks Bass Rocks near Gloucester, Mass. This scene was captured by 14-yr-old photographer Erik P. Smith.

Figure 12.--Labor Day was a day of labor for many Rockport, Mass., boatowners, in the wake of Carrie. Photo by Peter Tuttle, Gloucester Times.

naissance crews found 45- to 50-kt winds around a 1002-mb center that was located some 350 mi east-southeast of Cape Hatteras. Carrie began to fill as she moved northwestward late on the 1st. Late on the 2d, Carrie turned toward the north-northeast and began to deepen once again. By midday on the 3d, her central pressure reached a low of 992 mb. Carrie was less than 60 mi south of Cape Cod. Her outer circulation was causing weather along the New England coast. There was a large 1025-mb HIGH centered just south of Newfoundland. The two systems produced a tight gradient along the New England coast causing maximum winds to occur away from Carrie's center. The situation was more typical of a north-

easter than a tropical cyclone.

High winds and wind-generated seas (cover) along with heavy rains and rain-generated floods did most of the damage. These effects were confined to coastal areas from Rhode Island to Maine. Providence was battered by 45-kt gusts while Boston reported gusts to 40 kt. In general, sustained winds ranged from 30 to 45 kt. A gust of 73 kt was reported at Point Judith, R. I., and one of 60 kt came in from Cape Cod. Rains were confined to within 70 mi of the coast and ranged from 2 to more than 10 in. At Tashmou on Martha's Vineyard, 12.50 in. of rain fell in about 16 hr. Rain was heaviest along the Massachusetts coast where totals ranged from 4 to 9 in. Other coastal areas were doused by 2 to 5 in.

Local flooding, winds, and surf caused considerable damage, particularly in Massachusetts (fig. 11). Plymouth was declared a local disaster area. Damage in Massachusetts was estimated at $1.20 million. Wind-toppled trees knocked down powerlines, blocked roads, and damaged homes and cars. Rain-filled streams flooded cellars and eroded shorelines. High waves also caused erosion and swamped hundreds of small boats (fig. 12). Many buildings suffered directly from wind damage, particularly walls under construction. At Rockland, Maine, a cottage was blown from its foundation, and near Eagle Lake a track washout caused a train derailment.

There were four deaths associated with Carrie--two in Massachusetts and two in Maine. In Maine, two people drowned in rough surf. An East Boston man drowned after a cabin cruiser capsized off Manomet Point. The other Massachusetts death occurred when a man overturned in a canoe on Long Pond in Freetown. Total storm damage in New England was estimated at $1.78 million.

Late on the 3d, Carrie turned extratropical. The following day the storm moved across New Brunswick. Carrie's remnants slowly petered out in the Gulf of St. Lawrence during the next few days.

HURRICANE DAWN, SEPTEMBER 4-14

The embryo of hurricane Dawn was tracked across the Atlantic during the last week in August. The actual birth took place in the Florida Straits during the evening of the 4th; a circulation characteristic of a tropical depression was observed. The fledgling storm moved across southeastern Florida and into the Bahamas on the 5th. Nursed by warm waters and fed by the tropical atmosphere, Dawn reached tropical storm strength on the 6th. During the next 24 hr, her course changed from east-northeastward to northeastward, her forward speed increased to 15 kt, and she became better organized. On the 7th, Dawn blossomed into a hurricane, slowed, and turned northward. Hurricane Dawn reached full maturity that same day near 35°N, 71°W. Winds of 70 kt blew around a 997-mb pressure center. Unfriendly blocking conditions off New England doomed Dawn to Dixie. Dawn was turned back about 50 mi off North Carolina's Outer Banks. This blow seemed to age Dawn rapidly, and by the evening of the 8th she was a tropical storm meandering southeastward. For the next few days, the storm continued to move in a southeasterly then southerly direction. Late on the 10th, a frustrated Dawn turned westward. By the 13th, in hostile Georgia coastal waters, the shriveling Dawn was a depression with an unusually small area of cloudiness and cyclonic circulation. For one last fling, the depression turned northeastward and brushed the Georgia coast. The following day, coastal radar men tolled the death knell, as the last evidence of cyclonic circulation vanished from their scopes.

Dawn caused no significant coastal damage since her maximum winds and heavy rains remained out at sea. Some local flooding and beach erosion did occur in the northern Bahamas.

THE MARINERS WEATHER LOG WELCOMES ARTICLES AND LETTERS FROM MARINERS RELATING TO METEOROLOGY AND OCEANOGRAPHY, INCLUDING THEIR EFFECTS ON SHIP OPERATIONS.

THE 1971-72 GREAT LAKES ICE SEASON

G. D. Linklater
National Weather Service, NOAA
Detroit, Mich.

The Great Lakes 1971-72 ice season was notable for an unseasonably warm fall and early winter, with an abrupt reversal in January to a colder than normal regime (fig. 13) which persisted through mid-spring. The winter navigation season was again extended through January, and the navigation season was opened fairly early in the spring with the aid of intensive icebreaking operations conducted by United States and Canadian icebreakers. Ice research and ice observation programs were stepped up with the aid of a $6.5 million congressional appropriation. Surface water temperatures were studied in detail with improved instrumentation and the use of airborne infrared temperature scanners. Various air bubbler anti-ice systems were tested in the critical channels of the St. Marys River. There were a greater number of ice observations, including an increase in ice-breaker probes and aerial reconnaissance. The addition of the EDISTO (fig. 14), an arctic type ice-breaker, added sorely needed muscle to the Coast Guard icebreaking fleet. Coordination between the various United States and Canadian agencies associated with the ice program was improved, resulting in reduced costly duplication of effort.

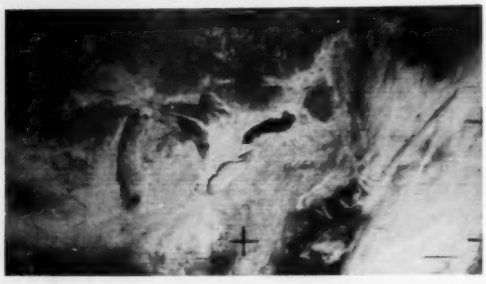

Figure 13.--Feb. 7, 1972--Almost total ice coverage of Lake Erie and Lake Superior. Note Lake Ontario, which is relatively ice-free.

The late season navigation program for the upper Lakes progressed through December with no unusual problems. During this period, above-normal temperatures kept the Lakes virtually ice-free. Then, early in January, arctic air pounced on the region, and with comparatively brief respites, poured over the Lakes through the rest of the winter and the early

Figure 14.--The 269-ft U.S. Coast Guard icebreaker, EDISTO, seen here in the Arctic. The sharply sloped bow, 6,515 tons, and 10,000 hp, enables her to easily crush 12 ft of new, hard sea ice.

Figure 15.--Heavy concentration of ice on southwestern Lake Huron and Georgian Bay on Mar. 10, 1972. Lake Michigan and Lake Ontario remain almost ice-free.

Figure 17.--On Apr. 27, 1972, the main body of all the lakes are ice-free, but drift floes and brash ice are jammed against the southern and western shores of the lakes and bays.

Figure 16.--Icebreaker tracks through the Thousand Island area of the St. Lawrence River on Mar. 31, 1972.

spring. Ice began forming rapidly during January, and icebreaker assistance was needed during the last 2 weeks of the month. The steamers, VOORHEES and FAIRLESS, locked downbound through the Soo Canals on February 1, setting a new record for late season operation.

Winter navigation over the lower Lakes was confined mainly to the "coal shovel" operation, a bulk carrier coal-hauling run, between Toledo, Detroit, and St. Clair. The coal runs operated through most of the winter, with only a short midwinter lay-up. Some icebreaking assistance was needed during late winter and early spring.

The St. Lawrence Seaway officially shut down December 15, but the locks were kept open an additional week to permit the last of the "salties" to return to the open sea. A Greek vessel, the AKRA RION, and a British freighter, the GRETAFIELD, shared the dubious distinction of being the last two ships to leave the Seaway.

Conditions were bad in early March (fig. 15); however, navigation over the upper Lakes resumed late that month when icebreakers opened the Straits of Mackinac to the steamers CRAPO and INGLEHART on the 28th. The St. Marys Waterway was officially opened April 7 and Whitefish Bay on the 8th, by a team of hard-charging icebreakers. The St. Lawrence Seaway (fig. 16) was forced open during March, and the Welland Canal, linking the Seaway with the four upper Lakes, was opened April 3.

Navigation over the upper Lakes was maintained with difficulty through April and early May. A cold spring retarded deterioration of the ice, and prolonged northeasterly winds jammed drift floe and brash ice onto the south and western sides of Lake Superior and the southern end of Lake Huron, and blocked the channels cut through the Straits and the Soo waterway (fig. 17). Constant icebreaker transits were needed to keep the traffic flowing. As the ice deterioration continued, brash ice clogged the channels, but high-powered vessels could push their way through.

There were other problems, drift floe ice carried down the St. Clair River and jammed the channel between Harsens Island and the Michigan mainland, isolating the Island residents. Infrequent emergency icebreaker passages and helicopter lifts were their only link with the mainland during the latter portion of April and early May.

Warmer May temperatures and spring showers eroded the lingering ice fields, and by mid-May ships and pleasure craft again were able to ply the Lakes unhindered by any unseasonal vestiges of winter.

The 1971-72 Great Lakes Ice season was a challenging period for all concerned--a long, grueling ordeal that tested ship and seamen alike. The crews of the icebreakers merit special commendation. They worked constantly in the ice fields, often on vessels partially disabled by the constant pounding of the ice.

Hints to the Observer

NONUNIFORM VISIBILITY

Frequently visibility is not reduced around the horizon circle in a uniform manner. Fog banks, showers, or haze may reduce visibility in only a portion of the circle. When only a part of the horizon is obscured, a simple rule for reporting visibility has been formulated: report the greatest distance objects are visible over one-half or more of the horizon circle. This is the definition of prevailing visibility or visibility index.

Let us look at two examples. In figure 18, at the time of observation, a fog bank has drifted in from the northwest reducing visibility in one-half of the horizon circle to zero. The visibility observed in the other half of the circle is 4 mi. Since the observed visibility is between two of the reportable distances listed under symbol VV on NOAA Form 72-1 (Ship's Weather Observation), the visibility would be reported as 2 mi (code figure 96), the lower of the two ranges.

Figure 19 shows nonuniform visibility caused by various weather phenomena obscuring portion of the horizon. One quadrant of the horizon circle is relatively unobstructed with a visibility of 4 mi. In the southwest quadrant, visibility is reduced to 3 mi by haze. Visibility is reduced by showers in the northern semicircle, with light showers in the northwest and moderate showers in the northeast. The observer can recognize objects at 2 mi to the northwest but only at 1 mi to the northeast. Since the visibility common to one-half or more of the horizon circle is 3 mi, this is the prevailing visibility. Code figure 96 is reported in the coded weather message.

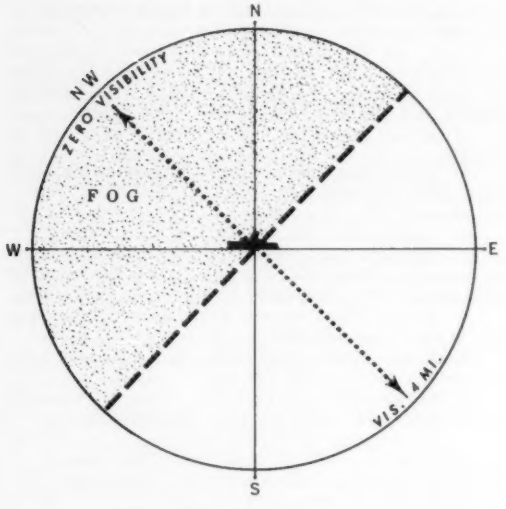

Figure 18.--Fog obscures one-half of the horizon circle.

Figure 19.--Various weather phenomena obscuring the horizon.

Tips to the Radio Officer

Warren D. Hight
National Weather Service, NOAA
Silver Spring, Md.

MARINE WEATHER BROADCASTS BY NEW COAST GUARD RADIO STATION AT PT. REYES, CALIF.

The National Weather Service and the Coast Guard has announced that a new marine weather service will commence with the inauguration of the new Coast Guard radio station at Pt. Reyes, Calif. (NMC) in February. (Point Reyes is about 35 mi northwest of San Francisco.)

The following is a preliminary schedule of transmissions:

A. Radiotelegraph (A_1) Broadcasts:

Frequency (kHz)	Time of broadcast (GMT)	Contents
420	0400, 1700	Coastal forecasts, Pt. St. George, Calif., to Pt. Conception, Calif.
8682 12788 17151.2	0030	Forecasts for: (a) North Pacific, north of 30°N and westward to 160°E (b) North Pacific, equator-30°N and westward to 140°W (c) Offshore waters: 20-250 mi
4346 8682 12788	0420, 0830, 1230	Same as 0030
12788 17151.2 22527	1615, 2030	Same as 0030

B. Radiotelephone (A_3H/upper sideband) Broadcasts:

2670	0200, 1400	Coastal forecasts, Pt. St. George, Calif., to Pt. Conception, Calif.

C. Radiotelephone (A_3J/upper sideband) Broadcasts:

8764 13147.5 17293.5	0000	Forecasts for: (a) North Pacific, north of 30°N and westward to 160°E (b) North Pacific, equator-30°N and westward to 140°W (c) Offshore waters: 20-250 mi
4383.8 8764 13147.5	0130, 0405, 0510, 0800, 0930, 1200, 1330	Same as 0000
13147.5 17293.5 22643	1600, 1705, 2000, 2130	Same as 0000

D. Radiofacsimile (F_4) Broadcasts:

4346 8622 12788	0530	Charts showing analysis and prognosis of weather and sea conditions for eastern North Pacific
12788 17151.2 22527	1730	Same as 0530

PUBLICATION WEATHER SERVICE FOR MERCHANT SHIPPING

The publication, Weather Service for Merchant Shipping, is being revised and will appear with the new title, Worldwide Marine Weather Broadcasts. It is expected that the new edition will be published early this year.

NATIONAL WEATHER SERVICE MARINE WEATHER WARNINGS TO BE BROADCAST BY NAVAL RADIO STATION NBA, BALBOA, CANAL ZONE

In the past few months, merchant ships in the eastern North Pacific have complained that the marine bulletins broadcast by Naval Radio Station NBA, Balboa, C. Z., no longer contained warnings for the eastern North Pacific waters.

The Naval Communications Command has agreed to arrange for relay to, and transmission by, Balboa Radio NBA of the warnings issued by WSFO San Francisco for the eastern North Pacific between the Equator and 30°N, east of 140°W.

CORRECTIONS TO PUBLICATION U.S. AND FOREIGN COASTAL RADIO STATIONS ACCEPTING SHIPS WEATHER OBSERVATION MESSAGES

Page 5

(a) In note near bottom of page which reads: weather messages addressed to "METEO WASHDC," etc., delete the words: or on page 1.

(b) Delete entry for NBA Balboa, Canal Zone

(c) Reinsert NBA Balboa, Canal Zone at bottom of page, preceding PJC Curacao. List the working frequencies 470, 4352 (2300-1100), 8614, 12883 kHz.

(d) Station NMA, Miami, Fla.: Amend frequency list to show only 440 kHz.

(e) Station NMY, New York, N.Y.: Amend frequency list to show only 486 kHz.

(f) Station NMN, Norfolk, Va.: Amend frequency list to read: 466, 8465, 12718.5, 17002.4 kHz.

Page 11 - Station NRV, Guam: Add 12786 kHz.
Page 12 - Station ZLW, Wellington, N.Z.: Add frequencies 8702, 13056, and 17170 kHz.

NOTE OF APPRECIATION TO RADIO OFFICERS

We appreciate comments and pertinent information sent in by radio officers. Your contributions are used to update and increase the usefulness of our publications. Acknowledgment is made here of recent letters from the following persons:

T. Versnel, STRAAT COLOMBO
R. Palmer, AUSTRAL ENVOY
H. W. Tindell, VIRGINIA TRADER

On the Editor's Desk

NATIONAL WEATHER SERVICE ANNOUNCES CHANGE IN MARINE STORM WARNINGS

The National Weather Service issued a change in terminology for the traditional announcement to small-craft operators of marginally hazardous weather conditions. Instead of "Small-Craft Warnings," these weather messages are to be called "Small-Craft Advisories," to reflect more accurately the true nature of their content. The change will take effect for salt-water sailors on January 1. It was introduced to Great Lakes boaters in 1971.

The Weather Service has an ascending series of alerting messages for mariners. These are keyed to increasingly hazardous weather. The lowest rung in the ladder has been the small-craft warning--for winds of about 18 to 33 kt and/or dangerous sea conditions. Next in urgency is the gale warning (for winds of 34 to 47 kt), then storm warning (48 to 63 kt or more), and lastly the hurricane warning (winds of 64 kt or more produced by a tropical cyclone).

All but the small-craft warning are based on well-defined meteorological conditions, and will remain the same. The small-craft warning is less precise, and varies in meaning from one locality to another. In response to objections from mariners about vagueness and variability, the Weather Service is switching to the word advisory, and informing mariners to decide for themselves whether the observed or forecast conditions constitute a real danger to them.

If you are a small-craft sailor and see the familiar red triangle fluttering in the breeze, the advice is: Tune in the latest marine weather forecast. Then you decide if you are experienced enough in boat handling and if your boat is seaworthy enough to cope with the expected weather--or whether you had better stay in port.

A sample Small-Craft Advisory is shown below, as it will be issued over the Weather Service's teletypewriter circuits:

DELAWARE BAY
SMALL CRAFT ADVISORY IN EFFECT
WINDS NORTHEAST 20 TO 30 KNOTS THIS AFTERNOON...SHIFTING TO NORTHWEST 20 TO 30 KNOTS TONIGHT AND 15 TO 25 KNOTS WEDNESDAY. WEATHER...RAIN POSSIBLY HEAVY AT TIMES THIS AFTERNOON ENDING TONIGHT...CLOUDY WEDNESDAY. VISIBILITY...1 TO 3 MILES IN RAIN AND FOG...IMPROVING TO 5 MILES OR MORE TONIGHT.

Along with this change in terminology, marine weather forecasters have begun to issue by radio a new warning that carries the label "Special Marine Warning Bulletin." No visual displays accompany the bulletin. It is issued whenever a severe local storm or strong wind of brief duration is imminent, and is not covered by existing warnings or advisories. Boaters will receive these special warnings if they keep tuned to a Weather Service VHF/FM or Coast Guard radio station, or to a commercial station that carries marine weather.

OCTOBER HURRICANE CLOBBERS FIJI

Hurricane Bebe made a bid to become the South Pacific's storm of the century during late October. This out-of-season storm devastated the British Gilbert, Ellice, and Fiji Islands. Preliminary reports indicate that 150-kt winds and torrential rains generated 50-ft waves, storm tides, and floods that left 28 people dead and thousands more homeless and hungry.

On the 24th, Rotuma Island reported 150-kt winds. Later that afternoon as Bebe crossed Viti Levu, the largest of the Fiji Islands, the Marine Department at Lautoka reported winds of more than 150 kt. Heavy rains on the south side of the island pushed rivers to 20-ft heights. Earlier, Funafuti, a series of low coral islets in the Ellice chain, was swamped by heavy seas.

Bebe was first detected by satellite between Gilbert and Ellice Islands on the 20th. She headed south-southwestward at less than 10 kt (fig. 20). The storm intensified and grew. By the 22d, her circulation extended out 600 mi (fig. 21). The hurricane turned toward the southeast on the 23d and the following day moved through the Fiji Islands. Bebe was at her peak at this time, but the rugged journey across Viti Levu sapped her strength. On the 25th, Bebe began to turn extratropical.

Bebe was the first hurricane since 1952 to clobber the Fiji Islands. Hardest hit were the outlying Yasaw group and the large island of Viti Levu. Along exposed coasts, winds and tides knocked down huts,

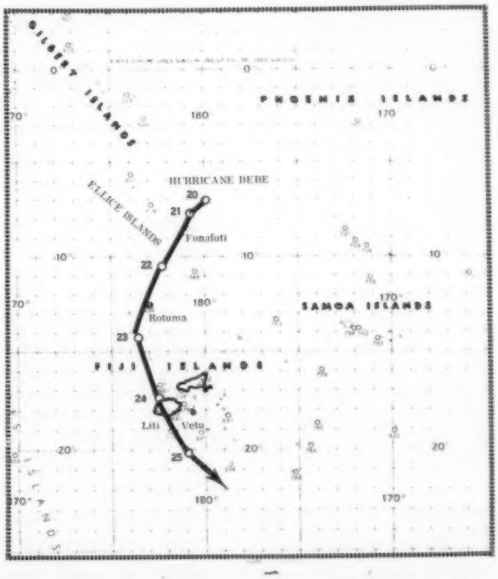

Figure 20.--Track of a rare October South Pacific hurricane. Bebe tracks southward over the Fiji Islands.

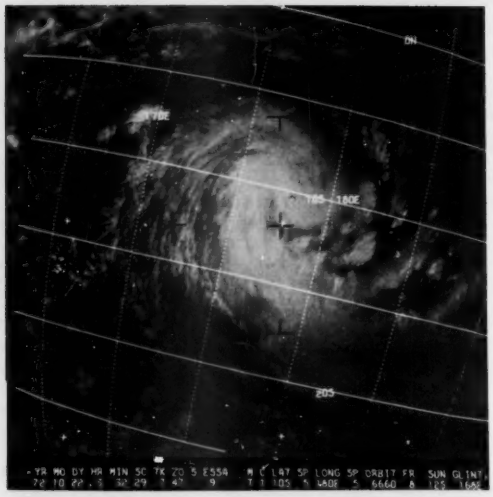

Figure 21.--Bebe is well developed with a conspicuous eye, when picked up by ESSA 9 on October 22, at 0332.

and drowned livestock (back cover). Southern Viti Levu suffered more from torrential rain-generated floods. Rivers bathed miles of farmland in 4 to 5 ft of water. Eighteen people are feared dead in the Fiji Islands. Farther north, Rotuma Island was devastated and little information is available. Funafuti was completely inundated. About 90 percent of the island was destroyed. Total storm damage for the South Pacific has been estimated at $20 million.

In addition to rebuilding, the islanders have been faced with a critical food shortage. Livestock drowned. Mango, breadfruit and coconut trees were uprooted. Rice, tapioca and kamal were wiped out. Drinking water was fouled. It will take at least 3 mo for new crops to be grown and harvested. Food and clothes have been donated by surrounding neighbors, such as New Zealand, Australia, and Hawaii. Commercial airlines provided cargo space for the supplies. The long rebuilding process has begun.

While tropical cyclones are not unheard of in the South Pacific, devastating hurricanes are rare. When they occur, it is usually in season, between December and April. The South Pacific lies on the fringe of the eastern Australian tropical cyclone region, where activity is centered in the Coral Sea. In an average season, the area from 135°E to 160°W spawns nine tropical cyclones--three or four of which become hurricanes. Nearly two-thirds of all storms occur during January, February and March. October is an unlikely month for a hurricane. This October was unusual.

BUOY DRIFTS FROM SOUTH CAROLINA TO SCOTLAND

A 10-ton navigational buoy had been flashing a red light every 4 sec, confusing local mariners. The mariners had a reason to be confused. This particular buoy, drifting 5 mi from the Orkney Islands off Northern Scotland, belonged in Port Royal Sound, S.C. It had been missing from its station for more than 13 mo.

When the crew of the British Lighthouse Tender, POLE STAR, hauled the buoy out of the water, they were surprised to find that it wasn't one of their own. The construction was unusual, it was in very poor condition despite the fact that its light and gong were still working, and it looked as if it had been at sea for quite a while.

Thus, began one of the most unusual searches undertaken by the Northern Lighthouse Board--a search that ended after 6 weeks of international letterwriting. Was the buoy from the coast of Iceland? Or could it have drifted from Norway, or possibly the coast of the Low Countries on the North Sea? Was it possible that it had drifted across the North Atlantic from Newfoundland where the Canadian government maintains a buoy system?

Finally, the riddle was solved. The Canadian Department of Transport forwarded their request for information to the U.S. Coast Guard's Office of Marine Environment and Systems in Washington. They, in turn, asked their Aids to Navigation Division if they were missing any red-flashing buoys, After a thorough search, it was discovered that the buoy the British found was one that was torn from its moorings off Port Royal Sound, S.C., in a storm on April 20, 1971. It had been one of eighteen buoys that guided ships into Beaufort, S.C. This was the buoy that the Northern Lighthouse Board of Great Britain had found--still working--13 mo and 3,200 mi later.

SEPTEMBER-OCTOBER ERIE WATER LEVELS BREAK 100-YR RECORD

The Lake Survey Center reports that Lake Erie has broken previous record high water levels for September and October and will probably set a new record for November.

Lake Erie's monthly mean level of 572.11 ft for September 1972 broke the previous high for that month of 572.04 ft, which occurred in September 1861. The October level of 571.95 ft replaced the previous October record of 571.81 ft, set in 1861. And, while complete records are not yet available for November, indications are that the lake may also top the record high set for that month in 1861. The Lake Survey Monthly Bulletin of Lake Levels' 6-mo forecast (furnished by the Detroit District, U.S. Army Corps of Engineers) indicates that Lake Erie should start to fall toward the end of November, but that it will remain above both its long-term and its 10-yr average levels during the next 6 mo.

The current high levels reflect the general above-normal precipitation conditions and other contributing factors in the area of late. When either high or low water supplies occur for an extended period, corresponding high or low water levels develop in the lakes. In addition, these tend to remain after the factors causing them have returned to normal, primarily because of the vast size and physical characteristics of the Great Lakes system.

OCEAN CURRENTS BEING OBSERVED BY SATELLITE-TRACKED BUOYS

Ocean scientists with Miami's Physical Oceanography Laboratory (PhOL) have embarked on a program for the experimental observation of ocean currents by means of drifting buoys tracked by satellite. The

project, designed to investigate large-scale properties of mean surface flows in the western Atlantic Ocean, is a cooperative venture with the French Space Agency CNES. CNES supplied the instrument package for the buoys, the satellite, and tracking facilities; PhOL designed the experiment, deployed the buoys, and will attempt recovery at the experiment's end. The deep-draft spar buoys are equipped with sensors for temperature and pressure and were built for PhOL by NOAA's Engineering Development Laboratory in Miami.

During the week of September 20, five drifting buoys were deployed from the University of Miami vessel RV GILLISS (fig. 22) approximately 600 mi apart along the 67°W meridian from 23.5°N to 28.0°N. Each of the five buoys are 41 ft long and about 3 ft in diameter; while at sea, the upper mast extends 10 ft out of the water. The white and orange mast is equipped with an antenna, a radar reflector, and a flasning white light for night visibility. The buoys are attached to a subsurface parachute drogue and have a trailing sensor cable that returns data on water temperature at the surface and at a depth of about 100 m. The RV RESEARCHER, on its return from the Great Lakes, picked up one of the buoys in mid-December.

All buoys were launched without mishap and have been returning data on their position, pressure, and water temperature several times daily to the tracking center at Bretigny Sur Orge, France. The data indicate the buoys are moving as fast as expected, although the PhOL scientists admit that direction of movement does not coincide as neatly with prediction. Except for the one buoy launched at 25°N, 67°W, all are moving at about 12 mi per day; the northern drifters are heading generally to the northeast while the southern ones are moving west-southwestward. The errant buoy moved less than 10 mi in 2 weeks. It is expected that all buoys eventually will drift west into the influence of the Gulf Stream and then move to the northeast. Present predictions indicate furthest northward drift coincides with the latitude of Long Island.

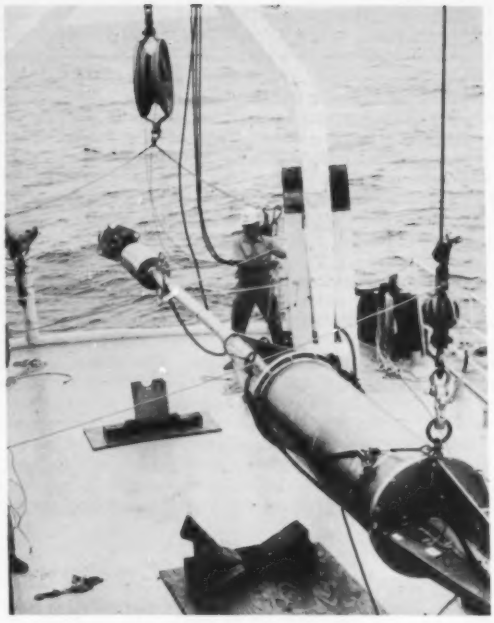

Figure 22.--RV GILLISS launching buoy to track ocean currents.

LETTERS TO THE EDITOR

SPECIAL WEATHER REPORT FROM THE PETER REISS

The following letter was forwarded to me by William E. Kennedy, Port Meteorological Officer, Cleveland-Hopkins International Airport, Cleveland, Ohio. The letter was written in response to a request from Kennedy to describe the severe thunderstorm that the PETER REISS encountered on Lake Erie. The special weather report submitted by Captain Grainger triggered the issuance of a Severe Thunderstorm Warning (fig. 23) for the exceptionally high wind speed. This also illustrates the sudden onset of severe weather that ships on the Great Lakes may encounter.

"The SS PETER REISS was enroute to Detroit from Sandusky with a load of coal and we took the route through the islands. The weather was calm; it was more or less a sultry day. Quite a few small craft were out as we passed through the islands. The first notice of weather was indicated by what appeared to be a consolidation of small strips or wisps of dark clouds into a mass--similar to a magnet drawing them together--and with each joining, the mass became darker. At this time, the ship was past Middle Sister Island enroute for Bar Point Channel. Middle Sister Island is south of Pelee Island.

"The cloud buildup seemed to stretch from Toledo, Ohio to Monroe, Mich. The mass seemed to roll

SEVERE THUNDERSTORM WARNING
EAWS REQUESTER

NATIONAL WEATHER SERVICE CLEVELAND OHIO
ISSUED 740 PM EDT AUGUST 10 1971

A SEVERE THUNDERSTORM WARNING IS IN EFFECT UNTIL 9 PM EDT FOR PERSONS IN OTTAWA, SANDUSKY, SENECA, ERIE AND HURON COUNTIES OF OHIO.

A LINE OF THUNDERSTORMS WAS REPORTED BY RADAR MOVING INTO THE WESTERN PORTIONS OF THIS AREA AND WILL MOVE TO THE EAST PORTIONS OF ERIE AND HURON COUNTIES AROUND 9 PM. THE STEAMER REISS AT WEST SISTER ISLAND, 15 MILES NORTHWEST OF PORT CLINTON, REPORTED WINDS OF 100 MPH AT 730 PM EDT.

A TORNADO WATCH IS ALSO IN EFFECT FOR THE AREA.

**
**

FEUSI KMFM 102

Figure 23.--An excellent observation from the PETER REISS was responsible for the above Special Severe Thunderstorm Warning.

rather than float or drift closer. The radarscope showed a heavy mass 10 mi in length and 4.5 mi deep. It was moving on the scope at a good speed and changing the angle of approach from horizontal to about 45° with the general mass steady. I watched it closely; I was looking for some waterspout activity or something similar. I had never seen any buildup of clouds so fast, prior to this. A weather warning call was put on the ship's phone as soon as it hit us. We had heard no forecast for intense storms in this area. The wind increased in speed from 5 m.p.h. to an estimated 100 m.p.h., when the storm's full force passed over us. That point was reached when the radarscope showed us to be about three-fourths of the way through the mass. Rain of torrential proportions accompanied the wind, with the lake being whipped into waves of 6 to 8 ft or more. It seemed like a solid wall of water for several minutes. The squall passed over us and everything returned to normal in a matter of 7 min from the first wind and rain to no wind and rain again. As it passed over us, the radarscope was a solid mass, 5 mi in diameter. I watched as it moved off and appeared to separate into two distinct masses about 5 mi from us; it was as though passing over the ship had separated it in some way or other. Prior to the wind and rain hitting the ship, I could see it coming as water sprites were skipping along and I could actually sense something heavy coming.

"As there was no weather equipment to measure speed on the PETER REISS, I estimated the speed as up to 100 m.p.h. as I did not want to minimize it. It was the strongest wind I've ever encountered in some 23 yr--spring, fall, or winter--and I have not missed too many storms over the years. I used this experience as a base for estimating the speed. Hope I did right in doing so.

"I would say that the squall line was moving toward the northeast at the start and then split--one part going southeastward, the other continuing easterly. The rain was horizontal not vertical. Windwise, no wonder. The decks were awash with water 3 in. deep, for the rain was so heavy that it could not run off as fast as it was coming down.

"I've tried not to exaggerate in this letter, yet cover all aspects of the storm at the same time."

Captain Grainger will receive a National Weather Service "Public Service Award" for his timely report which alerted the forecasters on duty.

MV SONETTE RIDES OUT TYPHOON HELEN IN NAGOYA HARBOR

The data in table 2 were recorded by the MV SONETTE, commanded by Captain G. E. Liljefors, during the passage of typhoon Helen over Japan. The SONETTE was anchored near Nagoya, at 34.8°N, 136.7°E on September 16 and 17. These data were recorded on a handmade log indicating only time/date, wind direction, speed in Beaufort Force, barometric pressure and remarks.

The eye of Helen (fig. 24) passed 50 to 60 mi west of the SONETTE at approximately 1300 on the 16th. She caused extensive damage and many deaths throughout Japan. Many ships and fishing boats were damaged or destroyed in Ise Bay.

Items such as the above, concerning meteorology and oceanography as it affects ship operation, are welcomed by the editor.

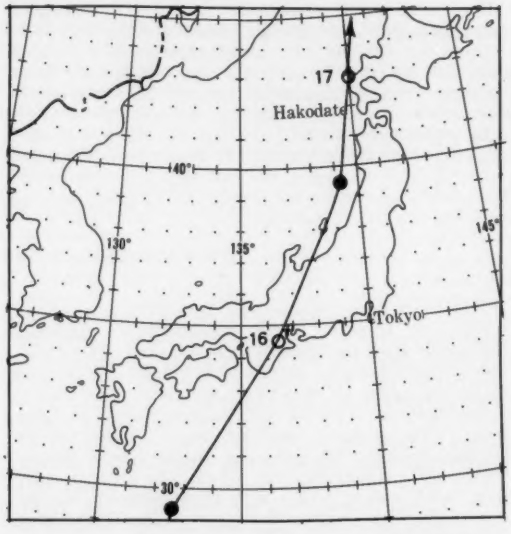

Figure 24.--The track of typhoon Helen on September 16 and 17 as she passed near the SONETTE. Open circle idnicates 1200 GMT position, and closed circle indicates 0000 GMT position.

Table 2.--Weather observation from the MV SONETTE while at anchor near Nagoya (34.8°N, 136.7°E) Sept. 16-17, 1972, when typhoon Helene hit Japan

Time	Wind direction	Speed	Barometer	Remarks	Time	Wind direction	Speed	Barometer	Remarks
0600	SE	4	1014	Slight rain	1500	SW to S	10-11	982.5	Moderate rain
0700	E	7	1003	Slight rain	1530	SW to S	11	986	Moderate rain
0730	E	8	998	Moderate rain	1600	SW	12	988	Moderate rain
0800	E	8	997	Moderate rain	1630	SW to W	11	991	Slight rain
0830	E	8	996	Moderate rain	1700	WSW	12	993	Slight rain
0900	E	8	992	Moderate rain	1730	WSW	10	995	Slight rain
0930	E	9	991	Moderate to heavy rain	1800	W to S	7	996	Drizzle
1000	ESE	9	990	Moderate to heavy rain	1830	W to S	7	996	Drizzle
1030	ESE	9-10	987	Moderate to heavy rain	1900	W to S	7	997	Drizzle
1100	ESE	10-11	983	Heavy rain	1930	W	6	999.5	Intermittent drizzle
1130	ESE	12	980	Heavy rain	2000	W	5	1001.5	Intermittent drizzle
1200	ESE	12	975	Very heavy rain	2100	W	4	1002	Intermittent drizzle
1230	SE to E	12+	971.5	Very heavy rain	2200	W	2	1003	Clear weather
1300	SE	12+	970	Very heavy rain	2300	W	2	1003	Clear weather
1330	SE to S	6-7	971.5	Slight rain	0000	WSW	3-4	1004.5	Clear weather
1400	S to E	11	976	Moderate to heavy rain	0100	S	2-3	1005	Clear weather
1430	SSW	11	980	Moderate rain					

MARINE WEATHER REVIEW

Smooth Log, North Atlantic Weather

July and August 1972

The SMOOTH LOG (complete with cyclone tracks [figs. 25-28], climatological data from U.S. Ocean Station Vessels [tables 3-6, 8] and gale tables 7 and 9), is a definitive report on average monthly weather systems, the primary storms which affected marine areas, and late-reported ship casualties for 2 mo. The ROUGH LOG is a preliminary account of the weather for 2 more recent months, prepared as soon as the necessary meteorological analyses and other data become available. For both the SMOOTH and ROUGH LOGS, storms are discussed during the month in which they first developed. Unless stated otherwise, all winds are sustained winds and not wind gusts.

SMOOTH LOG, JULY 1972--Cyclone activity was near normal or below normal over nearly all of the North Atlantic. The waters of the eastern Norwegian Sea, the Baltic Sea, and those surrounding the British Isles hosted only three extratropical storms all month. None of these followed the primary track from northern Scotland across the Gulf of Bothnia to the Soviet Union. There was more activity over the Gulf of St. Lawrence and over the waters heading northward into the Davis Strait, but both of these regions were still undernourished. Only one LOW crossed the Great Lakes all month; its 1010-mb center touched northern Lake Superior on an east-northeasterly course for about 4 hr on the 12th. This was the least amount of cyclone activity over the Lakes in 12 mo.

Although the 1023-mb Azores High was slightly weaker than normal, it was spread out more in the directions of Florida and the British Isles. Consequently, pressures from the Gulf of Mexico to the Baltic were above normal except over the central ocean where they were as much as 3 mb below normal near 38° N., 41° W. The Azores High actually contained two centers this July--one near 30° N., 44° W., and the other near 37° N., 26° W.--which were 300 to nearly 900 mi away from its normal location (35° N., 44° W.). The 1014-mb Greenland High was near normal in central pressure and settled over the icecap near 77° N., 44° W., or almost 400 mi southwest of its average July resting place. Positive pressure departures of 7 mb were exhibited over the Gulfs of Bothnia and Finland, and 5-mb anomalies extended as far west as the waters off western Ireland. Positive 4-mb anomalies lay over the Canary Islands and over the Gulf of Sidra. Three-millibar positive departures were common from the northwestern Gulf of Mexico to the Ohio Valley and over central Quebec. The Icelandic Low followed the example of the Azores High and also split into two parts. The stronger center (1008 mb) rested off the west coast of Iceland near 64° N., 27° W., while the weaker Low (1010 mb) was positioned near Cape Smith on the shores of Hudson Bay. The latter center was relatively close (150 mi west-southwest) to the normal position of the Icelandic Low (1009 mb) during July. In addition to the 3-mb negative anomaly over the central ocean, pressures were also 3 mb below normal from the Horn of Iceland to the Greenland Sea.

There were no tropical storms or hurricanes reported over the North Atlantic for the first July since 1968. Most folks along the Eastern Seaboard did not object since they were still picking up the pieces left after Agnes' disastrous June floods.

Monster of the Month--The first cyclone to cause shipping concern was initially detected over east-central Illinois late on the 2d. The PAUL H. CARNAHAN was rocked by 54-kt gales on Lake Michigan. Squalls had been sighted during the past hour, over the lake, as the warm front passed northeastward. The LOW (1011 mb) moved eastward for about 12 hr before starting to turn more toward the northeast. By 0000 on Independence Day, the 1008-mb storm was heading northeastward over southern Maine. Heavy rain fell at Caribou, Maine, at that moment. The cyclone scampered over the Gulf of St. Lawrence and Newfoundland's northern peninsula; it was near 51° N., 53° W., at 0000 on the 5th. Later that day, the LOW merged with another center of equal strength (1003 mb) laying south of Kap Farvel and deepened rapidly to 993 mb by 0000 on the 6th. Twelve hours later, the storm was southwest of Iceland near 61° N., 27° W.; its central pressure had dipped to a minimum of 979 mb. Gale-force winds had developed south of the monster by 0000 on the 7th when Ocean Station Vessel "I" near 59° N., 19° W. clocked 35-kt winds while fighting 20-ft swells during a shower. The 982-mb center became quasi-stationary near Keflavik, Iceland, by the middle of the 7th. At 1200 that day, the BUNTENSTEIN was hammered by 45-kt gales and 25-ft waves near 57° N., 26° W. Ship "I" measured 40-kt gales, and the EDENMORE near 56° N., 15° W. was struck by 35-kt winds at the same moment. The strong summer winds dropped off rapidly later that day, and gales ended by the advent of the 8th. The LOW filled to 990 mb by 1200 that day; it continued to remain relatively motionless while it did so. The cyclone did not adopt a definite course until 2 days later when it began moving eastward across the southern Icelandic coast; its 1003-mb center was last spotted early on the 11th near the Vesturhorn.

Late on the 9th, when the LOW described above was visiting Keflavik, another cyclone (990 mb) popped up off the southeast coast of Greenland near 65.5° N., 34.0° W. The cyclone headed down the coast until early on the 11th--about the time that the storm center over Iceland was in the process of losing its identity. The fresh, young LOW then made a U-turn near 61.5° N., 38.5° W., and started drifting northeastward; its central pressure rose to 998 mb by 0000 on the 12th. The ALEKSEY VENETSIAN was clubbed by 50-kt southwesterly gales 12 hr later near 55.5° N., 26.5° W., or 450 mi southeast of the 996-mb center. Minimal southerly gales persisted within an area southeast of the cyclone bounded by 55° and 61° N. and 15° and 27° W. through the 13th. The LOW tripled its speed during the middle of the 13th; it was over the Horn of Iceland at 0000 on the 14th. The next 24 hr were marked by the cessation of gales, a change in the storm's track to north-northeast, and a gradual filling to 1000 mb. By 1200 on the 15th, the central pressure had risen an additional 4 mb. The cyclone passed between Greenland and Svalbard and out over the Arctic Ocean, where it was no longer of any concern to mariners, on the 16th. It reintensified and maintained its existence for the next 6 days until dissipation took place early on the 22d northeast of Svalbard. During this 6-day stretch the pressure at the center of the LOW lowered to 986 mb between 0000 on the 20th and 0000 on the 21st.

A 1007-mb LOW appeared at about 0000 on the 23d near 40° N., 63° W., along a cold front stretching southwestward from another cyclone east of Labrador. While strengthening, the new cyclone journeyed eastward until the middle of the 23d when it swung north-northeastward to pass 175 mi southeast of Cape Race late that day. The storm had altered its path again and had decelerated by the advent of the 25th. The new course was northwestward, and by 1200 on the 25th the 985-mb LOW was over the Labrador Sea near 54° N., 49° W. Kap Farvel reported northerly 50-kt gales and heavy rain at the latter hour. The C.P. AMBASSADOR battled 40-kt southerly winds near 53° N., 43° W., 12 hr later, after the tempest deepened to 980 mb near 56° N., 48° W., and turned northeastward. Thirty-five-knot southwesterlies and 20-ft seas struck the MATTHIAS REHDER as she sailed the waters some 60 mi west of the AMBASSADOR.

The cyclone began to weaken rapidly later on the 26th, and gales ended by the end of the day as the central pressure soared to 998 mb. The third seasonally severe storm of the month became the third to pass over Iceland when it sped southeast of the Horn early on the 28th. The decaying storm then continued erratically northeastward, grazing Kap Tobin (Greenland) on its way, and finally washed out near 76° N., 12° W., early on the 30th.

A secondary LOW (1007 mb) came to life near the triple point of a frontal occlusion early on the 27th southeast of Newfoundland near 42° N., 52° W. The cyclone center headed east-northeastward for a few hours, and then, at about 1200 on the 27th, it curved northeastward and started to gain strength slowly. The DOCTOR LYKES reported 36-kt winds near 39°N, 53° W, at 0600 on the 27th. By 1200 on the 29th, the 998-mb storm was near 57° N, 26° W; it was about to alter course and aim for the British Isles. Near 50° N, 29° W, the AMERICAN LEGACY encountered 35-kt gales and waves of 13 ft. The LOW was filling slightly (1003 mb) when it sprayed the VEMA near 55°N., 17°W., with 35-kt west-northwesterly gales at 1200 on the 30th. Twelve hours later, when the cyclone was proceeding southeastward near Londonderry, Northern Ireland, the VALENTINE SEROV was also hit by gales of the same velocity near 50° N., 12° W. The storm center crossed the Irish Sea to England; it lay near Liverpool at 1200 on the 31st. Forty-five-knot winds lashed at a ship on St. Georges Channel at that hour as the LOW underwent some short-lived deepening to 1000 mb. The center reached the North Sea near Immington at about 1700 on the 31st and then drifted northward.

The storm was on its last legs when August arrived. The North Sea center dissipated and another reformed over the Netherlands late on the 1st. After remaining quasi-stationary for nearly 24 hr, the new center was absorbed by another cyclone lying over the Norwegian Sea, east of the Lofoten Islands.

The concluding intense July storm which I will speak of developed during July but reached maturity in August. The LOW traced its heritage back to a stationary front oriented mainly in an east-west fashion from New Mexico to the waters southeast of the Grand Bank of Newfoundland. An actual center (1011 mb) was first noted near 36° N., 70° W., at 0000 on the 29th. The ATLANTIC COGNAC was doused by mod-

erate rain to the north of the cyclone near 38° N., 67° W., and the DOCTOR LYKES was being slightly buffeted by 40-kt gales, 400 mi south of the fledgling storm's center, at that moment. The young LOW adopted a northeasterly track right from the start, and by 0000 on the 31st, the 1006-mb center was sporting gale-force winds in its southwest quadrant. The BRATSK was struck by these 35-kt northerly winds near 41° N., 59° W. (320 mi from the storm core) at that hour. Twelve hours later, the USNS NORWALK, at 38° N., 50° W., was being hit by 35-kt gales. Gales had spread out ahead of the 996-mb cyclone's cold front by 0000 on August 1 when Ocean Station Vessel "D" (44° N., 41° W.) battled 40-kt winds and heavy rain. At least four vessels, including "D," reported minimal 35-kt gales within the southern semicircle of the tempest 24 hr later. One of these vessels, the BEECHWOOD near 50° N., 39° W., was pounded by 33-ft swells while only 100 mi southeast of the LOW. The other ships encountering gales were the NICOLAS BOWATER near 46° N., 42° W. and an unidentified vessel near 46.5° N., 49.0° W. The LOW's central pressure continued to drop during the next 12 hr; it touched bottom at 990 mb at 1200 on the 2d near 53° N., 39° W. The STOVE SCOTIA was hammered by 45-kt west-northwesterly winds near 47° N., 37° W. and the ELBE EXPRESS fought 40-kt gales near 49° N., 43° W., at that hour. Continuing northeastward, the cyclone filled to 996 mb by 0000 on the 3d. Gales ended abruptly and were not observed near the LOW on the 3d. The storm dissipated near 60° N., 28° W., early on the 4th.

Casualties--During thick fog on the 22d, the 7,275-ton Greek vessel SIMOS ran aground near Sagres, Portugal. It was refloated after some cargo was jettisoned.

SMOOTH LOG, AUGUST 1972--August, usually a good sailing month in the North Atlantic, was even better than average. The large subtropical High was larger and stronger than normal. This resulted in a 1- to 3-mb jump in average pressures over almost the entire North Atlantic. Just east of the British Isles, pressures were 7 mb higher than normal. Storm tracks, usually at their northernmost point in August, were even farther north than normal. Cyclonic activity was most apparent in the waters around Greenland. The Davis Strait-Labrador Sea area was the scene of a number of late month gale-producing storms. The run from Labrador through the Denmark Strait was also besieged by several potent LOWS.

August usually accounts for two tropical storms--one of which becomes a hurricane. This August brought Betty and Carrie. These storms are described in the article, "North Atlantic Tropical Cyclones, 1972," appearing on page 6 of this issue.

The month's first intense storm formed in the latter part of July but reached its peak in early August, as it roamed northeastward over the waters south of Greenland and east of Nova Scotia. The storm was described in the July Smooth Log.

Although there was no lack of cyclonic activity, most August storms were weak. From the 3d to the 15th, no less than eight LOWS plied North Atlantic waters. However, gales were rare during this period. On the 5th, the AEGIR ran into 35-kt winds near 70°N, 10°W. Three days later, the NELLA DAN encountered 35-kt winds in the same area. The ESSO LIMA reported 40-kt gales near 34.9°N, 73.3°W. Another LOW over the Norwegian Sea generated 35- to 45-kt winds at Vigra, Norway, on the 10th and 11th. Also on the 11th, a LOW moving eastward from south of Greenland toward northern Ireland generated minimum gale-force winds in its southern semicircle. Two ships were hit by 35-kt gales along the LOW's frontal system, east of Ireland. The RITVA DAN reported 35-kt winds, after a frontal passage, near 57°N, 27°W, at 0000 on the 13th. The center of that LOW was some 350 mi to the north-northwest. The ESSO PUERTO RICO was blown by 42-kt gales at 27.7°N, 70.5°W, on the 15th. Weather was then quiet until the 19th.

On the 19th, a complex low-pressure system with a multiple center stretched from the Denmark Strait to the central Greenland Sea. It generated gales over shipping routes from the tip of Greenland to the coast of Norway. At 1200 on the 19th, a ship (Ocean Station Vessel "A") encountered 26-ft seas and 45-kt winds near 62°N, 32°W. Just south of Iceland, the TUNGUFOSS battled 35-kt winds. On the 20th, the 986-mb LOW continued to generate gales as it plodded northward. Gales at this time were confined to the Norwegian Sea. The storm turned northeastward and started filling over the Barents Sea on the 22d.

Monster of the Month--This storm began inconspicuously enough as a weak wave along a front on the western shore of James Bay on the 20th. It moved northeastward and reached the Labrador coast by 0000 on the 22d. By this time, the monster's pressure was down to 982 mb and it was threatening ships in the Labrador Sea and Davis Strait. Twelve hours later, with the LOW centered near 63°N, 57°W, central pressure was 964 mb and causing havoc among ships in the area. A ship (CGBN) near the center battled 18-ft seas and 65-kt winds. At the same time, Resolution Island was under a 40-kt siege. Gales were also blowing some 400 mi south of the LOW's center, which was heading northward for Baffin Bay. At 0000, the CGBN was battling 40-kt winds but the storm's central pressure was up to 975 mb. As quickly as the monster came to life, it began to die upon reaching the cold Baffin Bay.

A weak LOW that developed along a stationary front in northeastern Texas on the 22d, moved northward over Lake Michigan by the 24th. This system was not much to report on except that it triggered a torrential shower in the Chicago area on the 25th. In the northern and western suburbs up to 7 in. of rain fell in a 2-hr period before midnight on the 25th. This resulted in local flooding that turned major highway arteries into rivers. Officials had to open plugs on the Chicago River, which had threatened to spill over its banks.

On the 25th, a weak 1005-mb LOW from southern Baffin Island began moving southeastward over the Labrador Sea. The following day central pressure was at 988 mb and falling as the storm moved toward the open waters south of Greenland. The DAWSON ran into 40-kt winds off the Labrador coast, some 300 mi west of the 984-mb center, early on the 27th. Also Ocean Station Vessel "B" near the storm's center at

0000, reported 35-kt winds, and then encountered 50-kt winds in 28-ft seas at 1200, some 250 mi west of the center. Meanwhile, the CANOPIC encountered 50-kt winds 120 mi south-southeast of the center and the FEDERAL SCHELDE reported 40-kt winds 200 mi south of the center. The storm remained potent on the 28th as it swung northeastward to stay within 300 mi of the Greenland coast. Strongest winds were east and south of the storm's center, which was located near 60°N, 35°W. Winds along the southern Icelandic coast were up to 40 kt. Ocean Station Vessel "C" encountered 35-kt winds some 400 mi south of the LOW's center. At 0000 on the 29th, the MAYUMBE ran into 45-kt winds in 16-ft seas just 200 mi south of the slowly weakening storm's center.

Meanwhile, another storm had formed over western Hudson Bay on the 27th. By the 29th, it was centered over northeastern Quebec just south of Ungava Bay. Its central pressure was down to 984 mb. The next day it moved into the Labrador Sea. The MAYUMBE, a refugee from the previous storm, was buffeted by 50-kt winds in 16-ft seas just north of the storm's center. Some 180 mi southeast of the MAYUMBE, another ship (GOWS) was sailing in 35-kt winds and 10-ft seas. The LOW weakened as it moved northward into the Davis Strait as the month closed.

Casualties--The body of a Canadian man was found lashed to a section of a cabin cruiser when it washed ashore at Point Abino, Ontario, on Lake Erie, on the 28th. The man had been tied to the boat by his companion, after he had drowned in heavy seas the day before. Their boat was almost entirely awash, and the two men had clung to the forward part all Sunday night. The other man survived.

There were several ice incidents away from the Great Lakes. The 11,126-ton British freighter TAMMWORTH and the LETCHWORTH both reported at Churchill with ice damage. The RATTRAY HEAD collided with an iceberg 40 mi east of Cape Bauld, Newfoundland, on the 12th. She had some engine trouble, but required no assistance. Toward the end of the month, a bolt of lightning struck the 33,403-ton Greek tanker Princess Irene and touched off explosions which engulfed the ship in flames and split it in two. This took place dockside at Donges on the Loire River, France. The ship burned for several days and left six men dead and 26 injured. The 2,283-ton Greek ship, SUZY, sank in heavy weather near 40.9°N, 19.3°E in the Strait of Otranto on the 20th. At last report, three crewmen were missing and eight bodies had been recovered from the sea. The 777-ton barge MAGENS BAY, along with four other barges, the PBC161, U705, U706, and the U708, sank in a heavy storm on the 12th off the drilling rig, OCEAN VICTORY, in the Mississippi River. No injuries were reported.

Smooth Log, North Pacific Weather

July and August 1972

SMOOTH LOG, JULY 1972--Not a single cyclone developed east of the Honshu-Shikoku-Kyushu coastline during the month--a rather unusual occurrence since the primary July North Pacific storm track runs from Honshu to the central Bering Sea. In fact, the entire length of this cyclone track hosted below-normal activity. Three to as many as five LOWS pursued an easterly route from the Sakhalin-Hokkaido region to the waters southwest of the Gulf of Alaska, making this track above to well above normal. The main artery from the terminus of the above track to the heart of the Gulf of Alaska, however, entertained below normal activity. Although no extratropical LOWS came to life east of the bulk of Japan, the presence of numerous frontal troughs, typhoon Rita, and tropical depression Winnie led to negative pressure departures over Japan ranging from 1 mb around Hokkaido and northeastern Honshu to 5 mb over southern Kyushu.

The 1025-mb Pacific High near 37° N., 154° W. was 1 mb weaker than normal and 175 mi southwest of its average July location. The Aleutian Low, usually only a trough in July, was stronger than normal; its 1010-mb center lay southeast of Kamchatka near 47° N., 167° E. A 6-mb negative anomaly was centered close to the Low near 46° N., 170° E. Another Low (1001 mb), created by the presence of typhoon Susan, settled less than 100 mi south of the Macao-Hong Kong section of the Chinese coast. A negative pressure departure of 7 mb was centered over the central Ryukyus some 35 mi west of Naha. The monthly pressure over Kotzebue Sound was 6 mb above normal--the greatest positive departure of the month over the North Pacific and waters in close proximity to the North Pacific Ocean. This departure decreased to 5 mb over the northeastern Bering Sea and to 4 mb near the head of the Gulf of Alaska. A positive 3-mb anomaly rested over the tropical waters of the eastern North Pacific near 19° N., 121° W.

Six named tropical cyclones (two of storm intensity, two typhoons, and two supertyphoons [Rita and Tess]) were bred over the fertile waters of the western North Pacific. A seventh, Alice, developed late and had built to a tropical depression as the month ended. She will be described in the August Smooth Log. Four named storms are normal for July west of 180°. Tropical storm Bonny flared up over the eastern North Pacific Ocean as a depression on the 27th.

The worst storm of the month and of cold core origin was detected along a stationary front near 39° N., 161° E., late on the 14th. The 1010-mb nascent LOW headed nearly due east to a point near 40° N. and the dateline by the advent of the 16th. Rapid intensification took place within the cyclone during the last half of the 15th, and this strengthening culminated in a 994-mb central pressure and gales. Forty-knot west-northwesterly winds smacked the ANDREAS U. near 36° N., 174° E., at 0000 on the 16th. Later that day, the storm began to fill and turn northward after it was blocked by the 1033-mb Pacific High, which was near 48° N., 140° W. The center crossed

Yunaska Island at about 1400 on the 17th; it was south of the Pribilof Islands near 56° N., 170° W., 10 hr later. High southerly winds roared across the Alaska Peninsula. Cold Bay clocked 45-kt gales at the 0000 on the 18th synoptic observation hour. These winds decreased to 35 kt, 12 hr later, after the LOW's central pressure climbed to 1010 mb over the waters between Nunivak Island and the Pribilofs. Life ended for the cyclone a short time later.

Two crew members of a 349-ton Japanese fishing boat, the MANRYO MARU No. 32, were swept away by high waves while operating in stormy Aleutian waters on the 22d. The missing men were identified as the second mate and a boilerman. The waves also hit a deckworker, who sustained serious head injuries.

The storm responsible for the deadly waves first breathed life north of Manchuria and east of the Yablonovy Mountains of the U.S.S.R. around 0000 on the 15th. The 990-mb center was immobile until the latter part of the 15th when it adopted a southeasterly track. By the time the cyclone emerged over the Tatar Strait at about 0800 on the 17th, its central pressure had risen to 998 mb. An unidentified vessel near 44° N., 153° E. combatted 35-kt southerly winds within the warm sector of the LOW at 0000 on the 18th after the storm center had crossed Sakhalin and had started heading eastward through the Sea of Okhotsk. The central pressure of the cyclone continued its upward spiral and passed the 1000-mb mark later on the 18th. For the next 3 days, the central pressure oscillated between 1001 and 1005 mb as the cyclone sauntered eastward along the 49th parallel and passed the 165th parallel by 1200 on the 20th. At that time, the C. E. DANT was near 49° N., 178° W., and encountering 35-kt winds with 13-ft waves. The PHILIPPINE MAIL was buffeted by 45-kt gales at 0600 on the 21st at 45° N., 176° E. By this time, the LOW had turned north-northeastward and crossed Agattu Island, Near Islands, at 2000 on the 21st. The MARINE CHEMIST was pounded by 16-ft waves as she sailed southwestward some 150 mi southeast of Agattu, 4 hr later. A steady rising pressure trend resumed on the 22d, and by 0000 on the 23d the 1010-mb center was over the central Bering Sea near 58° N., 178° E. Clinging to life, the LOW was able to survive until the middle of the 24th when it lost its identity southwest of St. Lawrence Island near 63° N., 173° W.

Typhoon Phyllis began as a tropical depression amidst the Caroline Islands. She finished as an extratropical storm in the Sea of Japan. On the 6th, she was spotted just north of Ponape. Phyllis moved northwestward. The following day she reached tropical storm strength. Crossing the 10th parallel at 155° E., the storm turned northward. It wasn't until the 10th that Phyllis reached typhoon strength. After a slow, erratic movement, the strengthening storm accelerated northwestward. By the 11th, Phyllis was moving northwestward at 10 kt. Maximum winds were estimated at 120 kt. Gusts were up to 160 kt. Sustained 100-kt winds extended out 25 mi. Gales reached out about 250 mi. The SALLY MAERSK was 300 mi north of Phyllis and caught 35-kt gales on her outskirts, late on the 12th. Phyllis waned slightly as she made for the Volcano Islands. She reached the Islands on the 13th. At 0000 that day, the SALLY MAERSK was again whipped by 40-kt east-southeasterly winds near 25° N., 150° E. The VENNACHAR was encountering 37-kt gales, 120 mi to the north. By the 14th, maximum winds were 80 kt. The following day, Phyllis moved northward across central Honshu. Torrential rains and strong winds whipped the Kanto, Chubu, and Kinki regions causing floods and landslides. The port of Nagoya suffered extensive flooding. Rainfall in excess of 10 in. was reported in Shizuoka Prefecture. At Yokohama, the port was closed to ships larger than 10,000 tons to prevent collisions in the Bay. There were at least seven deaths. Honshu had suffered a recent series of torrential rains, and these deaths brought the total of dead or missing to 436 since July 4. Phyllis weakened to tropical storm strength and became extratropical once out over the Sea of Japan where she dissipated near 42° N., 137° E., late on the 16th.

The first two supertyphoons of the season developed together in July. Rita began in the Mariana Islands, meandered through the Ryukyu Islands, and finally moved up the Yellow Sea. At about the same time (latter half of the 6th), Tess began in the Marshall Islands, moved across southern Honshu, and ended up in the Sea of Japan.

Rita reached typhoon strength on the 8th between Yap Island and Guam. Tess became a typhoon on the 12th about 200 mi northeast of Eniwetok Atoll. Rita developed rapidly as she moved northwestward. On the 10th, she became a supertyphoon. The next day, winds peaked at about 145 kt with gusts to 175 kt. Later that same day, Rita stalled near 18° N., 132° E. At 0600 on the 12th, the STEEL ARTISAN had 35-kt gales near 15° N., 135° E., which was about 250 mi southeast of the typhoon. Eighteen hours later, she was being buffeted by 40-kt gales as Rita dawdled and the ship sailed westward. It wasn't until late on the 13th, that a weakening Rita began moving northeastward. On the 14th, after crossing the 20th parallel near 135° E., she stalled again. The SEATRAIN PUERTO RICO, to the east, and the VICTORIA CITY, to the south, reported 35-kt winds, with swells up to 20 ft. The AMERICAN RACER, SALLY MAERSK, and the WENCHOW suffered the effects of winds up to 45 kt to the south of Rita on the 15th. Rita finally began moving northward, as a minimal typhoon, on the 16th. The ESSO WASHINGTON battled 55-kt gales near 18° N., 137° E., and the FUMI KAWA MARU battled 33-ft swells west of Rita, near 23° N., 131° E. at 1200 the following day.

On the 16th, Tess was reaching her peak as a supertyphoon. Maximum sustained winds were estimated at 140 kt, occasionally gusting to 175 kt. Her center was located near 17° N., 154° E. Tess had moved westward until the 15th when she turned toward the northwest. Tess had weakened as she moved past Marcus Island at a distance of 250 mi to the west. She lashed Marcus with sustained 35-kt east to southeasterly winds at both 0000 and 1200 on the 17th. Tess then began a gradual westward turn on the 19th, and the PIONEER CRUSADER found 50-kt gales at 26.6° N., 152.2° E., about 300 mi to the east.

Rita also turned westward on the 19th near 27° N., 134° E., and the TRENTON was bashed by 55-kt gales, 250 mi to the northwest. Rita's

rains and swells were already reaching the Ryukyu Islands and Kyushu. Maximum sustained winds were back up to 75 kt with gusts to 115 kt. The TAKUYO MARU, LONG BEACH MARU, and OJIKA all reported 45-kt gales from the southern semicircle of the typhoon during the 36 hr ending at 0000 on the 20th. Typhoon Rita moved through the northern Ryukyu's on the 20th, and the TRENTON was pounded by 60-kt winds and 16-ft waves at 0000. High surf battered the shores of Kyushu and Shikoku. On Yakushima Island, an 80-kt wind was recorded. Once into the East China Sea, Rita turned a large counterclockwise loop from the 21st to the 25th. During this period, she moved southward to the southern Ryukyus. At this time, torrential rains triggered flash floods and winds generated storm tides over southern Taiwan. Several villages were inundated, and a train was overturned, killing the engineer. Rita continued her loop, ravaging Okinawa on the 24th. Her maximum winds had climbed to 85 kt with gusts to 125 kt. The second time around Naze, Amanioshima Island recorded winds up to 64 kt. Rita moved northward on the 25th; tides on Kyushu ran 1 to 2 ft above normal. Torrential rains dumped more than 23 in. in 2 days on Mt. Yabitsu, Kyushu, and 9.68 in. in 24 hr in Kumamoto Prefecture. Ten inches of rain for the storm was common throughout southern Kyushu. On the 26th, Rita brushed Cheju Do Island off South Korea. The Japan Meteorological Agency that evening stated that Rita had become the longest-lived typhoon on record. It topped the previous record set by typhoon Sarah in September 1967. Later on the 26th, tropical storm Rita made landfall over the Liaotung Peninsula of China. She was last spotted over Inner Mongolia near 38° N., 108° E., late the next day.

Typhoon Tess was not idle while Rita was cavorting in the East China Sea. On the 21st, she hammered the LONG BEACH near 25° N., 151° E. with 40-kt southerly gales and 30-ft swells as her center moved between the Bonin and Volcano Islands. Tess then swung northwestward the following day. The PERRYVILLE had roaring 50-kt gales near 33.3° N., 136.2° E., on the 22d. Late on the 23d, generating 70-kt winds, Tess banged ashore over Honshu near Kobe and her fury was felt across Shikoku and Kyushu as well as over southern Honshu. Surf 6 to 12 ft high battered the Honshu coast in the Kanto, Tokai, and Wakayama Regions. At Sukumo, Shikoku, a 93-kt wind was recorded. Torrential rains caused floods and landslides. As far away as Tokyo some 1,800 homes were flooded and seven landslides were reported. In Saitama Prefecture, some 1,050 homes were inundated as the Yadagawa River overflowed. Rain was particularly heavy in the Kanto, Chubu, and Kinki regions. An estimated 29 people died, and 25 more were listed as missing. The island took its toll too, and late on the 23d a weakening tropical storm moved into the Sea of Japan. The following day, Tess had dropped to a depression off the North Korea coast.

While Rita and Tess were roaming the western North Pacific Ocean, typhoon Susan flared up briefly in the South China Sea. She was first detected as a tropical depression on the 7th about 200 mi west of the Luzon coast. Susan, on a northeasterly heading, reached tropical storm strength on the 8th. The KISOGAWA MARU near 18° N., 118° E. tangled with 45-kt gales just to the south-southeast of the storm center at 1200 on the 8th. The Japanese ship also radioed in a pressure reading of 995 mb. Susan then swung northwestward and crossed the 20th parallel near 117° E. For the next 2 days, Susan wandered aimlessly in this area, about 130 mi southeast of Hong Kong. During this period Susan attained typhoon strength. On the 10th, maximum sustained winds reached 70 kt with gusts to 105 kt. Fifty-five-knot south-southwesterly winds and 16-ft seas and swells raked the MEMNON near 20° N., 116° E., at 0000 that day. She remained a minimal typhoon for about 24 hr. On the 11th, Susan began to more slowly northeastward. She stalled on the 12th and then, generating 50-kt winds, moved ashore near Shan-t'ou, China, on the 14th. Susan dissipated inland near Yungan, Fukien Province, China, late the following day.

On the 21st, a tropical depression which would evolve into Viola was detected 350 mi southwest of Wake Island. The LOW moved north-northwestward during the next 3 days before swinging northeastward on the 24th. At 1800 that day, she was christened a tropical storm near 25° N., 162° E. Developing this far north, the storm had little going for it. The following day Viola reached her peak intensity, and the AFRICAN COMET was visited by 50-kt gales, 130 mi to the south-southeast. Maximum winds near her center climbed to 60 kt with gusts to 100 kt. The storm was moving northeastward at 30 kt. Viola remained at this strength into the 26th. Cold air intruded into the system on the 26th, and Viola was extratropical by 0000 on the 27th near 39° N., 166° E.

Viola was the first North Pacific tropical storm of the year to have a lengthy extratropical stage, although she was galeless throughout her cold core life. Viola (1004 mb) turned from a northeast to a northwest course on the 27th. She curved back toward the north-northeast after crossing the 45th parallel near 164° E., at 0000 on the 28th. She passed over Attu Island and entered the Bering Sea late that day. After deepening to 996 mb on the 29th and meandering over the central portion of the Bering Sea on the 30th, Viola again adopted a northwesterly track and was erraticated near Mys Navarin early on August 1.

On the last day of the month, tropical storm Winnie was named as she moved northwestward near 24° N., 126° E. She had first been sighted as a depression near 20° N., 130° E., 2 days earlier. Unlike Viola, however, she was close to land. Late in the day, she moved west-northwestward through the southern Ryukyu Islands. Winnie reached tropical storm strength as she passed near Miako Jima. Besides starting so far north, Winnie's development was hampered by her proximity to Taiwan. Maximum sustained winds reached 45 kt just before Winnie made landfall late on August 1 north of Fu-chou, China. Winnie moved to the P'o-young Hu region as a depression by the 3d, and then turned north-northeastward. She remained a depression until the 5th when she was overtaken and absorbed by a cold front and colder air west of Hai-Chow Wan, Yellow Sea.

Unlike Annette, the eastern North Pacific's first tropical storm of the current season, Bonny did not become a hurricane. July-born Bonny popped up suddenly near 19.0° N., 109.5° W., late on the 27th.

The storm adopted a west-northwesterly course, passing north of the Islas de Revillagigedo. Bonny achieved her greatest intensity (45-kt winds near her center with gusts to 70 kt) near 21° N., 114° W., about 24 hr after she was first detected. She turned westward and decelerated during the 29th, and her top winds dropped to 35 kt with gusts to 45 kt. Bonny was downgraded to a depression at the close of the 29th; she dissipated near 22° N., 120° W., early on the 31st.

Casualties--The 1,695-ton YI TAY struck a reef in heavy seas and ran aground at 34.3° N., 125.1° E., on the 8th. She was abandoned in sinking condition. The 1,708-ton Japanese freighter KINSEI MARU No. 11 encountered heavy weather on the 8th and sprang a leak. She sank on the 10th, 60 mi northwest of Luzon Island. All the crew was rescued. During heavy weather on the 12th, the ORIENTAL FALCON ran aground at 20.6° N., 116.9° E., and was holed. The vessel was pounded by heavy swells and abandoned by the crew.

SMOOTH LOG, AUGUST 1972--The Gulf of Alaska, usually at its quietest in August, was the scene of a flurry of cyclonic activity along the Alaska Peninsula. This resulted in a negative 8-mb pressure departure in the area. Central pressure in the large Pacific High was a couple of millibars down from its normal 1025 mb, but it still covered a good part of the Pacific. Cyclonic activity, as usual for August, was brisk in the Bering Sea. In more tropical waters, an above-average six hurricanes haunted the eastern North Pacific while an average four typhoons and one tropical storm roamed the waters of the western North Pacific.

A small LOW over the western Aleutians enlarged, intensified, and was soon a headache for mariners during the first few days of the month. By the 3d, it had moved east-southeastward into the Pacific. Central pressure dropped to 995 mb. Early the next day, the GOLDEN GATE BRIDGE encountered 40-kt winds along the 988-mb storm's cold front some 500 mi south of the center. The LOW finally settled over the Alaska Peninsula on the 4th. It dissipated slowly over the next few days.

On the 3d, a LOW formed in the northern part of the Sea of Japan. As it moved through the Soya Strait, the storm triggered 4 to 7 in. of rain over southern Hokkaido and northern Honshu. In southern Hokkaido, rain-swollen rivers flooded more than 1,000 homes and were responsible for one death and several injuries. The storm was not heard from again until the 8th, when the TOYOTA MARU No. 11 ran into 45-kt winds near the center at 37°N, 176°E. The LOW had paralleled the Kurils and was heading for the Aleutians on the 6th. However, it swung south-southeastward, then turned northward again on the 8th. The following day, gales were reported within 300 mi of the storm's center in the southwestern and southeastern quadrants. The 992-mb LOW continued to generate minimal gale-force winds as it continued through the central Aleutians on the 10th and 11th. Once into the Bering Sea, the storm filled rapidly.

A LOW that flourished briefly in the Yellow Sea and Sea of Japan on the 9th and 10th, dumped up to 7.5 in. of rain over Japan and raked the nearby China coast with gales. Wind and rain were responsible for the flooding of more than 800 homes in Japan. Tides ran up to 1.5 ft above normal. Hardest hit areas were around Tokyo, Kagoshima, and Gifu.

A small LOW that developed in the southern Sea of Okhotsk on the 11th survived the long Pacific crossing and caused havoc the following week along the Oregon-California coast. The storm never really developed as it crossed the ocean. On the 14th and 15th, it moved along the Aleutian Islands and up the Alaska Peninsula. The following day, the weak 1006-mb LOW turned southeastward and then southward. On the 17th and 18th, the storm paralleled the U.S. west coast at a distance of about 200 mi. Wind gusts up to 65 kt and 14-ft seas destroyed many small fishing and pleasure craft along the coast from Eureka, Calif., to Brookings, Oreg. Winds also ripped off roofs, toppled trees, and cut electrical power in many coastal communities. The death count stands at 13.

On the 17th, an active front trailed from another weak LOW over the southern Sea of Okhotsk across Northern Honshu and South Korea. As this quasi-stationary front drifted southward during the next few days, it triggered the heaviest torrential rains South Korea had witnessed in 47 yr. These rains in turn triggered floods and landslides. During a 30-hr period on the 18th-19th, Seoul was drenched with more than 17 in. Flooding occurred along the Han River, which flows through the capital. A 24-hr fall of up to 12 in. caused disastrous flooding along the Chinwichon River. In the southern provinces, 24-hr rainfall totals of 10 in. were common. Most deaths were because of flooding, and some were due to landslides. The death toll will be over 400 when figures become final. Seoul was hardest hit with more than 200 deaths and some 50,000 homes destroyed. The front and the wave that developed along it also dumped 4 to 10 in. of rain on the Hiroshima area of Honshu. The rains triggered landslides, which killed two people. Floods damaged more than 2,500 homes.

During the second half of the month, there was a flurry of extratropical activity in the Bering Sea. A series of LOWS moved northward and eastward through the area. The most potent of these was a 976-mb LOW that had moved across from the Kamchatka Peninsula on the 18th and positioned itself just west of Bristol Bay by the 20th. That day, Cold Bay recorded a 36-kt wind with gusts to 41 kt. The HENRIETTE W. SCHULTE, near 46°N, 174°W, ran into 42-kt gales along the cold front. The LOW then moved into the Gulf of Alaska where it dominated the weather scene until it was replaced by a secondary center on the 24th. These systems produced near gale-force gusts along the southeast coast of Alaska. They were also responsible for 2 to 5 in. of rain. On the 25th, Ocean Station Vessel "P" encountered 35-kt winds 300 mi south of the center of the 986-mb LOW.

The last week in August saw a deepening LOW move out of Siberia southeastward across the Bering Sea and then up toward the Gulf of Alaska. By the 29th, central pressure had dropped to 984 mb as the LOW crossed the Alaska Peninsula. The JAPAN MAIL reported 35-kt westerlies behind the cold front, and

the USNS SILAS BENT was bothered by 40-kt gales and 15-ft swells, 310 mi southwest of the storm's center. On the 30th, the USCGC CONFIDENCE, near Fox Island, rode out 40-kt northwesterlies. A few other reports of 30-kt winds were noted in the storm's southwest quadrant, that day. The storm remained stationary and started to weaken as the month came to a close.

Typhoon Alice, which began life as a depression late in July, was close to tropical storm strength by August 1 near 17°N, 160°E. The following day, she was a typhoon. She was also heading toward Japan. By the 3d, maximum winds measured 90 kt. Gusts were estimated at 130 kt. Winds greater than 50 kt extended out to 150 mi. Gales extended more than 200 mi from the storm's center. Late in the day, Alice swept 60 mi west of Marcus Island. The NIPPON MARU encountered Alice on the 5th. The ship was buffeted by 70-kt winds as it passed close to the storm's center (29°N, 147°E). Typhoon Alice plodded toward Japan, but her intensity waned slightly. As Alice approached Tokyo on the 7th, she began to recurve. That morning, six Japanese ships were forced back to Tokyo port. The STEEL DESIGNER bucked 40-kt gales, 200 mi east-southeast of the storm center. One to 2 in. of rain fell over the Kanto Region. Alice also triggered 2 to 3 in. of rain in Hokkaido. On the 8th, she completed an extratropical transformation near 41°N, 150°E.

Shortly after Alice turned extratropical, an inconspicuous depression popped up between the Caroline and Mariana Islands. This soon developed into supertyphoon Betty. The depression became a tropical storm on the 9th and a typhoon on the 10th as she crossed through the Marianas, north of Saipan. During this time, the LA SALLE, NAECO, and the SEATRAIN GEORGIA encountered 35-kt gales in various quadrants around the storm. On the 12th, near 14°N, 137°E, maximum winds were 85 kt. Gusts were 125 kt. Movement was toward the west at 11 kt. By the 13th, winds near the center were up to 120 kt. They reached 130 kt with 170-kt gusts by the time the center was near 20°N, 130°E, on the 14th. Gales extended outward nearly 400 mi. Supertyphoon Betty had a classic configuration. The SPIRIT OF LIBERTY ran into 55-kt winds about 150 mi south of Betty's center at 1200, and 60-kt gales at 1800 on the 15th. Six hours later, at 0000 on the 16th, the winds were 50 kt but she was rocked by 23-ft seas and 32-ft swells. The PRESIDENT ADAMS was belted by 65-kt typhoon-force winds 280 mi northeast of the eye, at 1200 on the 15th. The following day was a rough one for the TAKAMATSU MARU. She sailed in 55- to 60-kt winds and 40- to 50-ft seas for a good part of the day. On the 14th-17th, the following ships reported 35- to 45-kt gales" the AMERICAN CHALLENGER, ESSO SEATTLE, EXPORT COURIER, MARYLAND TRADER, MORMACGLEN, PRESIDENT TYLER, and the STEEL DESIGNER. Betty's intensity waned slightly as she approached land. But she remained potent as she moved through the southern Ryukyus and over the East China Sea. Betty battered Taiwan and left 15 people dead, five missing, and eight injured. Floods destroyed some 350 homes. On the 17th, Betty crossed the China coast north of Fu-chou. Out at sea, the TOKIWASAN MARU encountered 45-kt winds near 23°N, 125°E.

The storm was more than 300 mi away from the Philippines at its closest point, but rains from typhoon Betty triggered floods that ravaged the central plains of Luzon, just north of Manila. The floods swept through 21 towns and were responsible for at least six drownings. This area had barely recovered from its worst floods in history when Betty hit.

Typhoon Cora and tropical storm Doris came into the western Pacific spotlight on the 25th. Cora made her initial appearance in the South China Sea while Doris debuted far to the east near 26°N, 163°E. Both were in poor areas for a really big-time show. Cora was land locked, while Doris was too far north. Cora moved slowly westward from 19°N, 117°E, and managed to reach typhoon intensity before coming ashore on Hainan on the 28th. As a tropical storm, she reached North Vietnam late the same day. By the 29th, she had dissipated. Meanwhile, Doris moved northward during that period. Maximum winds reached 45-kt on the 27th. The THOMAS E. CUFFE measured 36-kt winds at 1200 on the 28th, about 100 mi north of Doris' center. The ROSE CITY had 35-kt gales at 39.9°N, 161.9°E, less than 30 mi west of the now tropical storm. She also rolled with 10-ft seas and 13-ft swells. At this time, Doris was well on her way to becoming extratropical as she crossed the 40th parallel near 163°E.

Typhoon Elsie squeezed in under the August deadline when she put in an appearance over the South China Sea on the last day of the month. Elsie was spotted near 13°N, 112°E. On September 1, she became a typhoon. She reached peak intensity on the 2d when maximum winds climbed to 70 kt with gusts to 110 kt. Elsie was moving westward toward South Vietnam. She rammed ashore just south of Da Nang early on the 4th. She was still at typhoon strength. However, once ashore, she began to dissipate rapidly.

A tropical disturbance about 450 mi south of La Paz, Mexico, on the 2d moved westward and stalled near 15°N, 120°W, on the 4th. It developed slowly into a tropical storm by the 6th, near 15°N, 120°W; it then moved slowly westward. No ships reported in the area until 0000 on the 7th when a vessel (WGBC) about 90 mi south of the center indicated westerly winds of 20 kt and a pressure of 1006.4 mb. Ships remained clear of Celeste except for the SANTA ISABEL MARU, which passed 150 mi southwest of the center at 1800 on the 8th.

A radio telephone call from the STAR TRACK estimated 80- to 90-kt winds near 16°N, 123°W, at 0054 on the 9th. During the rapid development, a three-masted square-rigged vessel, the REGINA MARIS, became involved in the storm and was damaged by high winds and rough seas. It began taking on 2,000 gal. of water an hour and issued a distress call. Two injured persons were treated onboard. The Air Force reconnaissance aircraft on a mission to observe the hurricane was alerted to the distressed vessel. That aircraft found it some distance from its estimated position, and guided a rescue aircraft to the REGINA MARIS. The rescue aircraft dropped pumps, gasoline, and supplies to the damaged vessel. The reconnaissance aircraft then continued on its mission. The VISHEA TRITH reached the sailing vessel and took it in tow until the USCGC MELLON

took over late on the 13th. Rescue and towing operations were complicated by the aftereffects of Celeste and the effect of hurricane Diana, which followed 1,000 mi and 4 days after Celeste.

Hurricane Celeste crossed 140°W at 14°N about 0900 on the 12th. For the next 2 days, she moved west-southwestward at about 10 kt. The storm passed south of the Hawaiian Islands on the 15th. The closest point of approach was near 0600 on the 16th, at a point 320 mi south-southwest of South Point on the Island of Hawaii. At this time, Celeste had turned gradually to a west-northwesterly course and headed for Johnston Island, a small coral island 700 mi southwest of Honolulu. Early (72-hr) forecasts provided ample opportunity for precautionary measures to be taken at Johnston. Later, the forecast for close passage of Celeste to Johnston caused the Air Force to evacuate all personnel from the island; this was accomplished the day before she struck. Celeste passed approximately 20 mi northeast of Johnston Island at about 0100 on the 20th. Damage reports from Johnston are incomplete, but damage is expected to be relatively light because the storm center passed north of the island and extensive reefs protect Johnston on the north side. Intensive preparation for the storm undoubtedly reduced damage potential. The hurricane undertook a northward turn just prior to passing Johnston and began to weaken. Nevertheless, at 0600 on the 21st, the AMERICAN LANCER, only approximately 20 mi to the north, was pounded by 55-kt gales, heavy rain which reduced the visibility to 0.5 mi, and seas of 10 ft, together with 24-ft swells. She was downgraded to a tropical storm by 1200 on the 22d near 21°N, 172°W, and rapidly dissipated thereafter.

Celeste was of considerable meteorological interest. The central Pacific sees relatively few tropical storms each year. Much rarer is a hurricane that forms off Mexico and moves west across the central Pacific while maintaining hurricane intensity. Also interesting was the fact that Celeste moved with few sudden changes of direction, intensity or shape. The storm-generated swell was felt on the south shores of the Hawaiian Islands. Swell estimated at 6 to 9 ft high in deep water caused occasional surf to 15 ft on exposed shores. The southerly swells from Celeste were observed in the Hawaiian Islands during the period of August 15th-17th.

Diana began developing in the wake of Celeste on the 8th. A circulation was first indicated in satellite pictures on the 10th near 9°N, 144°W, at 1800. Squalls and showers extended out 300 mi from the center. Winds of 20 kt or less were reported 200 to 500 mi from the center by the SANTA ISABEL MARU, CONON FOREST, and the STEEL ADVOCATE. The CONON FOREST, north of and converging with the storm, altered her course on the night of the 10th. She then sailed parallel to and at nearly the same speed as the storm, which increased to hurricane intensity on the night of the 12th near 13°N, 124°W, remaining in the vicinity of the storm until the 18th. The VISHEA TRITH, towing the disabled 117-ft square-rigged sailing vessel, the REGINA MARIS with 53 passengers, was headed northeast ahead of the storm in 30- to 40-kt winds to rendezvous with the USCGC MELLON near 17°N, 126°W, on the night of the 12th; the hurricane center was then about 120 mi to the south. The tow was transferred in strong winds and high seas, and the MELLON, bucking winds of 35 to 50 kt, headed northeast and east away from the storm.

A reconnaissance on the 14th showed no change in either central pressure or maximum wind. On the 15th, the Air Force reconnaissance reported Diana had weakened somewhat. The central surface pressure had risen to 982 mb, and maximum surface winds had diminished to 55 kt. Shortly after this reconnaissance report was received, Diana was downgraded to a tropical storm. At this point, Diana also changed course to the west and increased speed to 16 kt. The next three reconnaissance observations on the 17th and 18th gave no reports on minimum surface pressure, but all reported maximum surface winds of 45 to 55 kt with no changes in storm characteristics. Until 1800, Diana moved on a steady westerly course at an average speed of 16 kt. At this time the center was 300 mi east of the Island of Hawaii and the storm center was forecast to pass very near the southernmost point of the Island on the 18th. Early on the 18th, Air Force reconnaissance located the center north of the predicted path and a sharp change in both course and speed of Diana was in progress. A tropical storm warning advisory was then issued stating the storm would pass to the north. Reconnaissance on the 19th indicated further slowing and curvature toward the north. The central pressure of the storm was measured at 987 mb with maximum surface winds of 50 kt indicating further weakening had occurred.

On the morning of the 20th, the Air Force reconnaissance plane located the center of Diana 30 mi north of the Island of Maui with a minimum surface pressure of 1005-mb and maximum surface winds of 25 kt. Diana's career was over. She did manage to cause some damage, however. On the morning of the 18th, surf estimated at greater than 25 ft began pounding the southeast coast of Hawaii. At Kapoho Beach, damage to four homes was estimated at $70,000, excluding furnishings. Although rains did not produce floods, rainfall was large over most of the eastern side of Hawaii with pockets of very large rainfall occurring. Ten in. fell in a small area northeast of Hilo, and 8 in. fell in the Punaluu area southwest of Hilo. From rainfall data of the other islands, it appears only Maui received rainfall in any large amounts that were directly a result of proximity to Diana. One area along the northeast coast received up to 6 in. of rain during Diana's pass by the island.

After Celeste and Diana broke away and moved slowly into higher latitudes, squalls and thunderstorms continued along the Intertropical Convergence Zone and Estelle was born. On the 13th, satellite pictures showed signs of another circulation developing in the vicinity of Clipperton Island, 10°N, 115°W. By early morning on the 15th, a depression was located 650 mi southwest of Manzanillo moving westward at 8 to 10 kt. No ships were in the vicinity of the LOW, but several were within 300 to 500 mi of the center. These included the SETUN MARU, NORBEGA, COLUMBIA, and the DDQC. Satellite pictures taken on the 15th indicated continued organization and intensification of the depression, and late afternoon pictures suggested the system had become a tropical storm moving northwestward at 12 kt with maximum winds of 40 kt near the center. The deepening of the storm was accompanied by a slower northwestward movement. The

only reported gale wind of the storm was by the LLKJ, about 150 mi from the center at 1800 on the 17th. The SAN JUAN EXPORTER, on a northwesterly course, was closing on the storm late on the 18th. With winds and seas increasing, she elected to alter her course and pass to the south of the storm. Had she continued her speed and course, she would have passed through the center on the morning of the 19th, with 60-kt winds gusting to 80 kt.

Gradual intensification to hurricane strength continued. By late on the 19th, winds were estimated at 75 kt. The hurricane continued moving northwestward at 8 to 10 kt, began weakening, and was downgraded to a tropical storm late on the 20th about 1,300 mi west of Puerto Vallarta. Estelle continued on a northwesterly course at 10 to 12 kt until the morning of the 22d, when the circulation weakened with maximum winds of 30 kt. She then entered more westerly flow around the equatorial side of the Pacific high pressure area and dissipated near 27°N, 137°W, on the 23d.

An area of cloudiness about 500 mi south of Manzanillo, Mexico, on the 18th, developed rapidly into tropical storm Fernanda on the 19th. The FERNFIELD, 200 mi east of the center reported a southerly 25-kt wind, but the long swells reported were also from the south, indicating a recent development of the LOW. As the FERNFIELD sailed northwestward, she encountered heavy rains as the wind backed to southeast. The GREEN WAVE and UQRT were ahead of and outrunning the storm, but the FILEFJELL, heading southeastward, altered her course to the north with winds increasing to 40 kt, 180 mi northeast of the center, by 1800 on the 21st, near 12°N, 110°W. After sailing south of Diana on the night of the 16th, the WONOSARI continued on an easterly course to the Panama Canal. She crossed 250 mi south of Estelle during the night of the 19th and headed for an intercept with Fernanda in a little over 2 days. She altered course to the southeast late on the 21st, as Fernanda continued to intensify. The WONOSARI passed within 150 mi of Fernanda as the storm intensified to a hurricane, but reported only 20-kt winds at 0000 on the 22d. Passing beyond Fernanda, she went through the southern part of tropical storm Gwen during the night of the 22d and then into thunderstorms and squalls that were organizing to form a depression south of Guatamala on the night of the 24th.

Meanwhile, Fernanda continued as a hurricane on a west-northwesterly course developing 90-kt winds late on the 23d and 100-kt winds that night. The HOSELSTEIN, 200 mi southwest of the center, reported 45-kt winds and the BOGOTA, STEEL APPRENTICE, MOHAWK, THOR I, BANASOL, HONGKONG BEAR, and BRADFORD ISLAND were all in the vicinity of the hurricane, between the 23d and 24th. The strongest wind reported was 52 kt by the EASTERN GLORY on the 24th, 125 mi west-northwest of the hurricane, then centered near 18°N, 127°W. Fernanda was downgraded to a tropical storm on the morning of the 26th and crossed 140°W near 20°N during the afternoon of the 27th. She then moved westward and a little north, passing 150 mi north of the main Hawaiian Islands, Hawaii on the 30th and Kawai on the 1st. She continued to weaken and was last seen on the weather maps near 31°N, 157°W, on September 3.

A tropical disturbance near 9°N, 90°W, at 1800 on the 20th, moved westward to 400 mi east-southeast of Acapulco and developed into tropical storm Gwen during the night of the 21st. Forty-knot winds were reported by the CONTINENTAL MERCHANT and the SCOTSTOUN. The RICE QUEEN, about 75 mi offshore near Point San Telmo, reported 35-kt winds as the storm passed south of them. On the 22d, the course of the storm changed to northwesterly and the speed increased to about 15 kt. The strongest winds increased slowly to hurricane intensity on the 24th, and the center was located on satellite pictures near 16°N, 107°W, 400 mi southwest of Zihuatanejo. The hurricane continued northwestward, followed by Air Force reconnaissance aircraft, and in satellite pictures, reaching its greatest intensity 100 mi southeast of Socorro Island with estimated winds of 125 kt near the center. The hurricane passed over Socorro Island during the night of the 26th, a small but intense storm. The BANASOL, after passing north of Fernanda, passed south of Gwen on the 27th. The URRW outran the storm to the north. Numerous ships reported from the periphery of the storm: the AMERICAN LANCER, GRISCHUNA, NORTHBREEZE, SHELDON LYKES, TEXAS, and unlisted ships GOND, JBVY, JHOY, JPSI, and 6LEH. Late on the 29th, the hurricane decreased to tropical storm intensity near 25°N, 177°W. It continued northwestward, weakening further and becoming a tropical depression about 250 mi southwest of San Diego, where it dissipated late on the 30th. A weak surface LOW continued in the general area through September 1.

A weak circulation was indicated on satellite pictures 300 mi south of the Gulf of Tehuantepec on the 27th, and a tropical disturbance bulletin followed reports by the ACHILLE LAURO, CHEVRON ARNHEM, MOHAWK, and ALMIRANTE. The disturbance maintained its intensity and moved westward through 1800 on the 29th, when it developed into tropical storm Hyacinth and moved west-northwestward. The BANASOL reported 35 kt winds 150 mi to the northeast, and the THOMAS M reported 30-kt winds 100 mi north of the center at 0000, and 45-kt gales, at 0600 on the 30th, The EASTERN GLORY also measured 38-kt gales, slightly farther north. Air Force reconnaissance observed the storm at 1800 on the 30th, finding a central pressure of 984-mb and estimating winds of 80 kt near the center. The hurricane was moving west-northwestward at 12 kt. On the 31st, the Air Force found a central pressure of 972-mb and estimated winds of 110 kt. No flight was made on September 1, but on the 2d the lowest pressure of 962 mb was found near 19°N, 120°W. Such a central pressure could easily have developed winds in excess of 100 kt.

The storm was weakening on the 3d, and at 1800 the Air Force estimated winds of 70 kt. At 0000 on the 4th, it was downgraded to tropical storm intensity. The storm continued to weaken as it passed over cooler water and took a more northerly and northeasterly direction, reaching its westernmost point on the 4th near 27°N, 125°W. Thirty-knot winds were reported by the following ships unlisted in the AMVER Bulletin: GAUG, JBXC, and 4YQT. Thirty-knot winds were reported by GAUG 60 mi northwest of the center, by the PECAN 100 mi southwest of the center, and by the JBXC and 4YQT 60 mi west of the center, late on

the 4th.

Further weakening continued as the storm reached the coast. It went inland between San Diego and Los Angeles with only 20-kt winds.

Casualties--The 631-ton HAGIURA MARU No. 13 capsized in waters off Noto Peninsula, bordering the Sea of Japan, on the 10th. A cold front, associated with a 990-mb LOW just north of Vladivostok had swept through the area that day. All 10 crew members were rescued. On the night of the 29th, the ATLANTIC PHOENIX ran aground in dense fog, about 1/4 mi east of Awaji Island in Japan's Inland Sea. All crew members aboard the 21,338-ton British containership were unhurt. The 3,506-ton Swedish tanker THULELAND and the 11,136-ton Finnish tanker PALVA were both trapped by ice in the Barrow Strait in the latter part of August. They were escorted out by the ice breaker LABRADOR.

WE OF NOAA ARE MAKING USE OF THIS SMALL AMOUNT OF SPACE TO EXTEND OUR THANKS TO ALL THE SHIPS' OFFICERS WHO ROUTINELY TAKE SHIPBOARD WEATHER OBSERVATIONS. TO US, THESE EXCELLENT OBSERVATIONS ARE PRICELESS. WE CERTAINLY DO APPRECIATE RECEIVING THEM ON A REGULAR BASIS.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

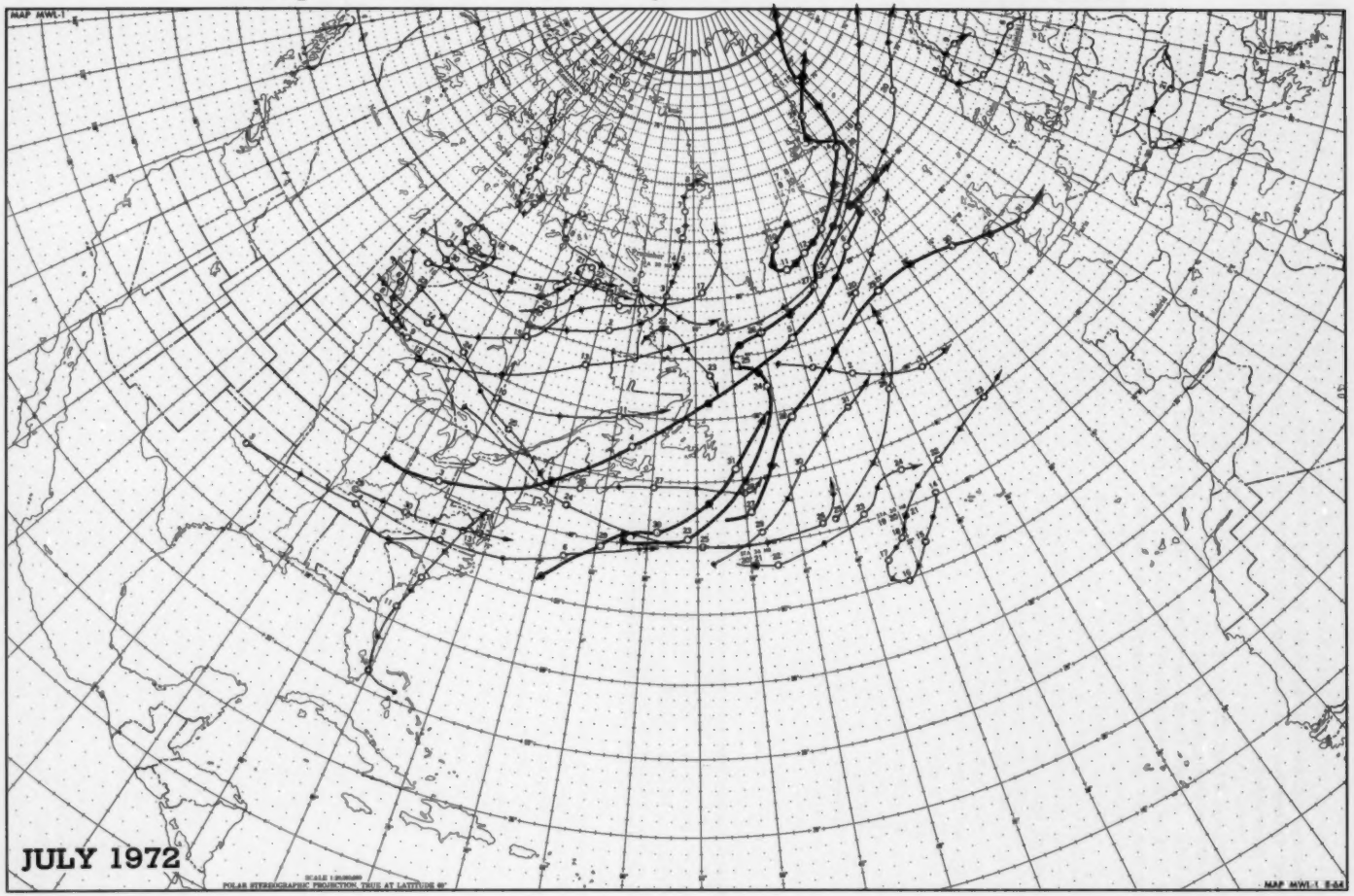

Figure 25. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Atlantic

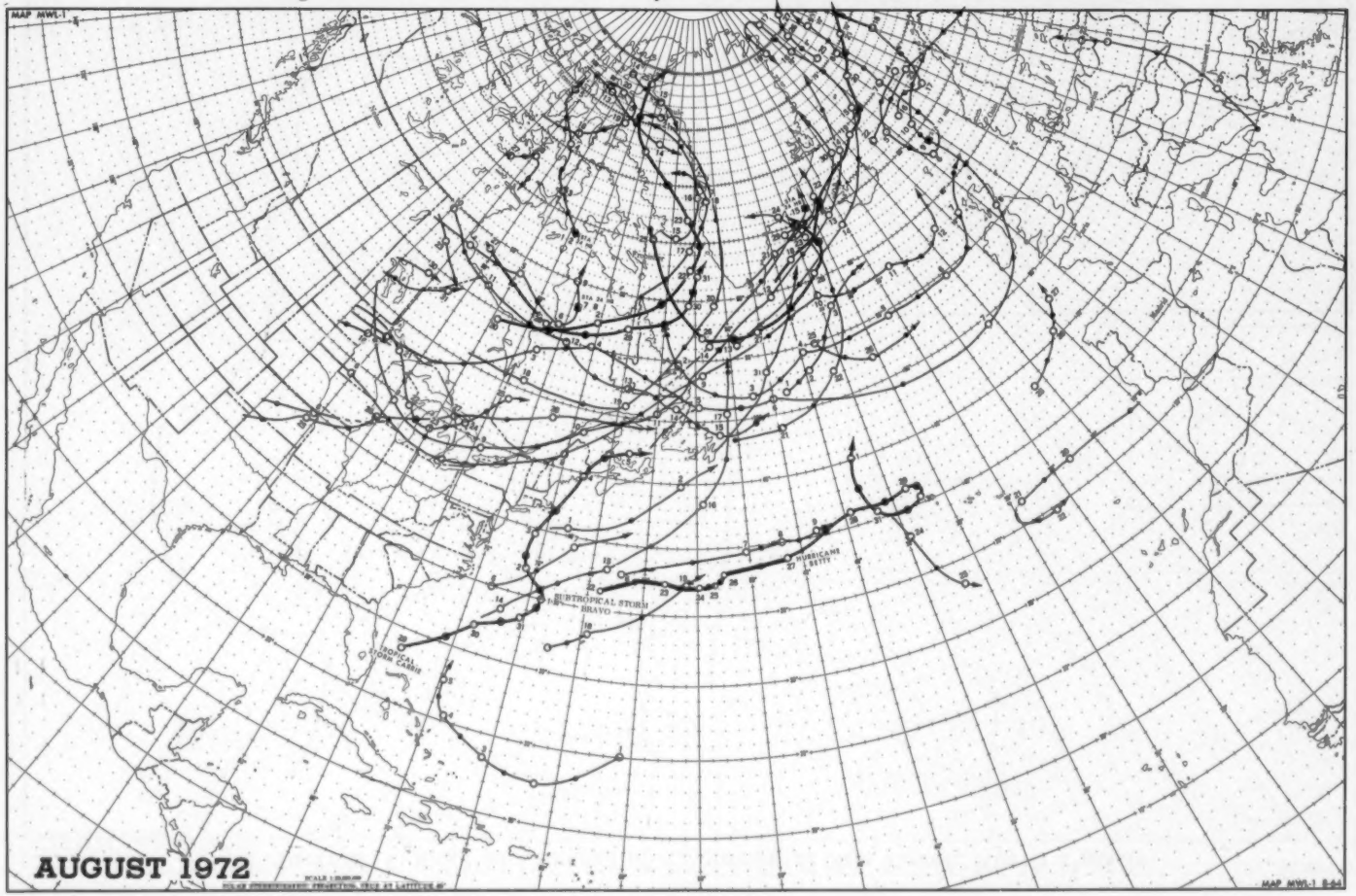

Figure 26.--Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

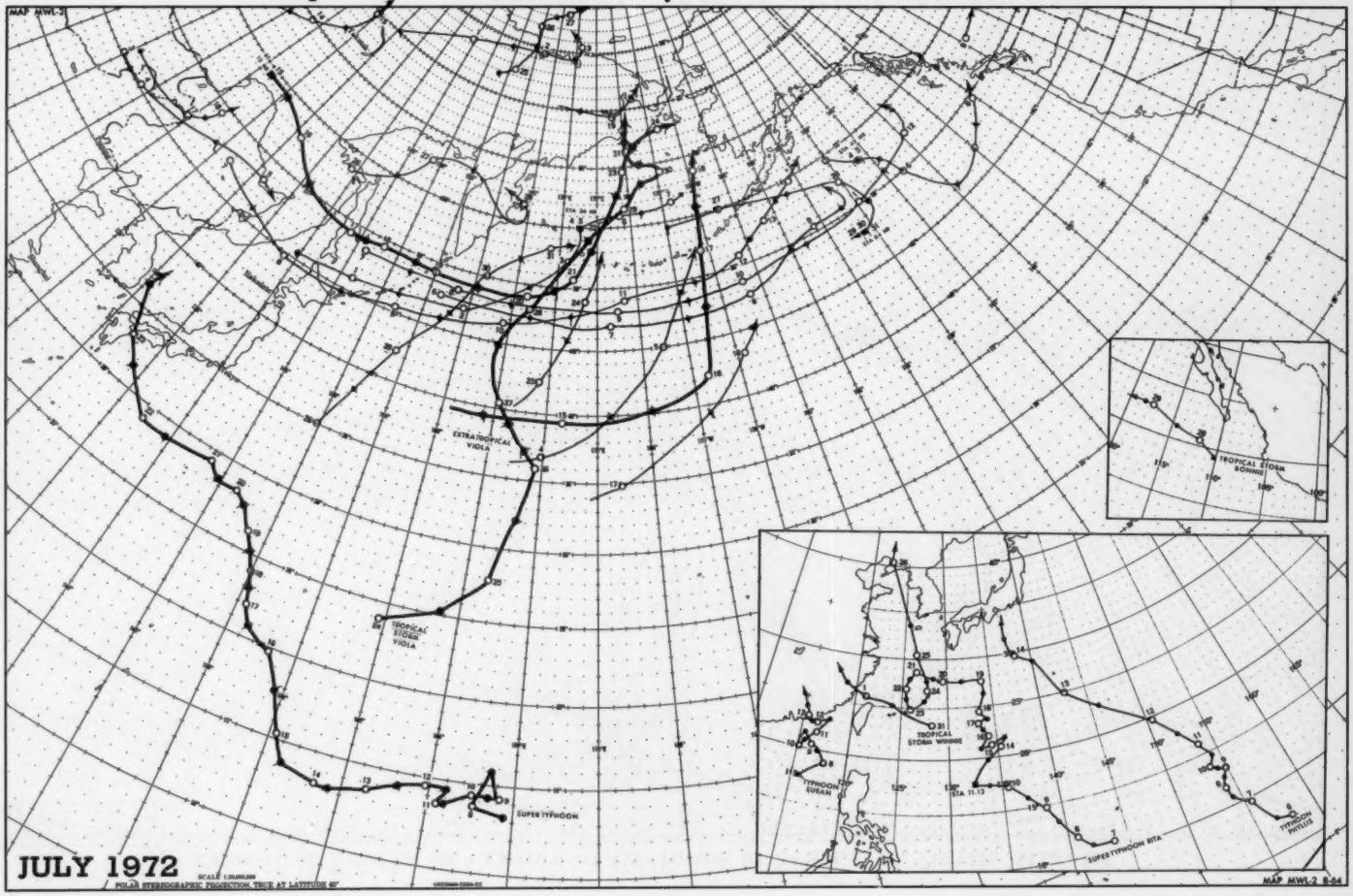

Figure 27. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Principal Tracks of Centers of Cyclones at Sea Level, North Pacific

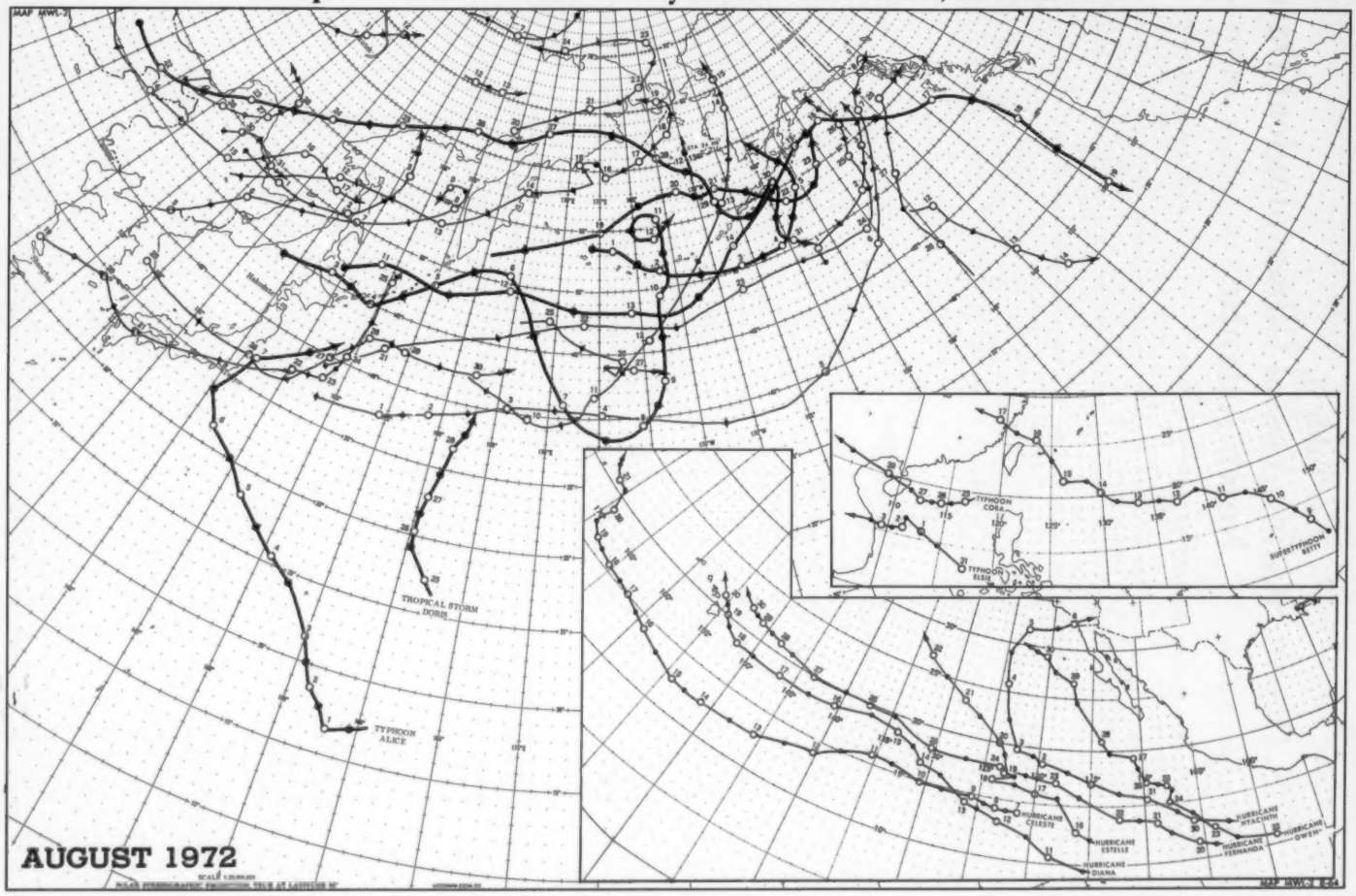

Figure 28. --Open circle indicates 1200 GMT position and closed circle 0000 GMT position. Square indicates stationary center. Cyclone tracks marked with a heavy line are described in the Smooth Log.

Table 3
U.S. Ocean Station Vessel Climatological Data
North Atlantic

Ocean Weather Station 'BRAVO' 56°30'N 51°00'W **July and August, 1972**

MEANS AND EXTREMES

	DRY BULB TEMP (°C)					DEW-POINT TEMP (°C)					SEA TEMP (°C)					AIR-SEA TEMP DIFFERENCE (°C)				
MONTH	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR	MIN	DA HR	MEAN	MAX	DA HR
JULY	4.0	01 03	8.3	9.1	*28 21	.8	11 06	4.6	7.4	31 18	4.4	18 18	6.1	8.9	19 03	-2.7	19 03	.2	2.9	02 18
AUG	3.5	18 03	7.6	10.7	16 18	.9	28 03	6.0	9.8	16 18	4.7	28 03	7.7	9.3	17 00	-3.9	27 21	-.1	2.8	*30 15

MEANS AND EXTREMES — PRESSURE (MB)

MONTH	MIN	DA HR	MEAN	MAX	DA HR
JULY	968.0	14 09	1014.1	1025.9	18 21
AUG	980.8	27 03	1009.9	1020.9	01 00

PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS)

	TOTAL CLOUD					LOW CLOUD				
MONTH	0-2	3-5	6-7	8 & OBSC		0-2	3-5	6-7	8 & OBSC	
JULY	18.9	10.2	27.5	43.4		39.8	10.2	11.9	38.1	
AUG	12.5	5.4	21.7	60.4		29.4	13.3	22.9	34.3	

DAYS WITH SPECIFIED WEATHER

MONTH	RAIN OR PCPN	DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	TOBS WITH PCPN	NO OF OBS
JULY	14	10	0	0	13	2	0	0	30	12.7	244
AUG	24	24	0	0	11	3	1	0	28	27.9	240

** VV-90-93 AND/OR W-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

JULY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

	WIND SPEED (KNOTS)							
DI	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	2.7	2.6	.3	.0	5.5	22.4
NE	.0	.4	1.3	1.3	.1	.0	3.2	19.9
E	.0	4.0	3.4	.0	.0	.0	8.0	9.9
SE	.0	1.5	7.2	3.6	.0	.0	12.3	17.8
S	.0	4.1	8.5	3.4	.0	.0	16.0	15.3
SW	.4	5.7	7.7	.4	.4	.0	14.7	12.6
W	.4	4.9	9.0	1.9	.4	.0	17.6	14.0
NW	.4	7.0	10.6	4.0	.0	.0	22.3	14.3
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	1.6	26.7	51.2	17.2	1.2	.0	100.0	14.8

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
244	280	40	14	1400	3.4	248	

AUG — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

	WIND SPEED (KNOTS)							
DIR	<4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.4	3.3	3.4	.8	.0	.0	7.7	11.0
NE	.0	4.2	7.0	1.9	.0	.0	13.0	14.0
E	.4	5.1	7.6	.8	.0	.0	13.4	12.8
SE	.0	6.3	5.7	.9	.0	.0	13.1	12.0
S	.0	1.1	8.0	3.1	.7	.0	13.0	18.0
SW	.0	1.4	7.7	4.0	.5	.0	13.5	18.6
W	.0	1.3	7.9	1.5	1.3	.8	12.5	20.4
NW	.0	3.8	5.5	2.2	.8	.6	12.8	17.8
CALM	.8	.0	.0	.0	.0	.0	.8	.0
TOTAL	1.7	26.7	52.9	14.2	3.3	1.3	100.0	15.7

NUMBER OF OBS	MAX WIND DIR	SPEED	DA	HR	VECTOR SPEED	MEAN DIR	(DIR IN DEGREES)
240	290	50	27	0600	2.6	236	

Wave

JULY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

	WAVE HEIGHT (METERS)								
DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	5.6	3.1	2.2	1.0	.0	.0	.0	9.9
NE	.0	2.9	1.8	1.0	.5	.0	.0	.0	6.3
E	.0	7.4	2.7	.4	.0	.0	.0	.0	10.5
SE	.4	3.2	4.9	.1	.0	.0	.0	.0	8.6
S	1.1	10.5	4.1	.7	.0	.0	.0	.2	16.4
SW	2.2	7.0	.8	.8	.0	.0	.0	.0	10.8
W	1.5	7.0	1.4	1.2	.0	.0	.0	.2	11.2
NW	.9	12.2	6.0	1.2	.1	.7	.0	.2	20.3
IND	1.2	4.1	.9	.0	.0	.0	.0	.0	6.1
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	7.0	59.8	25.8	7.8	1.6	.7	.0	.2	100.0

NUMBER OF OBS 244 IND-INDETERMINATE

AUG — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

	WAVE HEIGHT (METERS)								
DIR	<1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.7	2.9	1.8	.7	.0	.0	.0	.0	6.1
NE	.2	5.7	5.7	1.3	.0	.0	.0	.0	12.9
E	.9	6.8	6.1	1.4	.0	.0	.0	.0	17.2
SE	2.3	5.8	.5	.9	.0	.0	.0	.0	9.4
S	.0	9.1	3.5	.9	.7	.2	.0	.0	14.2
SW	.0	2.4	4.4	1.8	.5	.0	.0	.0	9.1
W	.0	1.9	3.1	1.9	1.9	.4	.9	.0	9.3
NW	.0	4.7	5.2	.1	.2	.0	1.5	.0	11.7
IND	.0	7.5	2.5	.0	.0	.0	.0	.0	10.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.2	49.2	32.9	7.9	3.3	.4	2.1	.0	100.0

NUMBER OF OBS 240 IND-INDETERMINATE

JULY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	5.7	37.3	9.8	.0	.0	.0	.0	.0	53.3
6-7	.0	18.4	14.1	6.0	1.6	.0	.0	.0	39.8
8-9	.0	.0	.0	.8	.0	.0	.0	.0	.8
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	1.2	4.1	.9	.0	.0	.0	.0	.0	6.1
TOTAL	7.0	59.8	25.8	7.8	1.6	.0	.0	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA	HR	IND-INDETERMINATE (DIR IN DEGREES)
244	4.0	7	020	SEA	15	06	

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

AUG — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	4.2	22.9	5.0	.0	.0	.0	.0	.0	32.1
6-7	.0	13.8	17.1	4.2	.0	.0	.0	.0	35.0
8-9	.0	9.0	7.3	2.5	2.9	.4	.0	.0	18.3
10-11	.0	.0	.8	1.3	.4	.0	2.1	.0	4.6
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	7.5	2.3	.0	.0	.0	.0	.0	10.0
TOTAL	4.2	49.2	32.9	7.9	3.3	.4	2.1	.0	100.0

NUMBER OF OBS	MAX WAVE HEIGHT HGT	PER	DIR	TYPE	DA	HR	IND-INDETERMINATE (DIR IN DEGREES)
240	9.0	10	300	SEA	27	13	

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 4
CLIMATOLOGICAL DATA

Ocean Weather Station 'CHARLIE' 52°45'N 35°30'W — July and August, 1972

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JULY	7.5	06 06	10.4	14.4	22 21	.9	07 21	9.0	13.3	22 18	7.9	01 03	9.6	13.7	22 21	- 1.4	17 21	.8	3.4	22 18
AUG	8.2	13 09	11.7	14.3	22 12	9.0	26 21	10.1	14.0	17 21	10.0	08 06	11.3	13.9	08 15	- 3.2	08 03	.4	2.9	12 12

MEANS AND EXTREMES — PRESSURE (MB)

MONTH	MIN	DA HR	MEAN	MAX	DA HR
JULY	992.7	25 09	1018.4	1028.3	31 00
AUG	997.4	02 21	1014.7	1029.9	19 12

PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS)

MONTH	TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC
JULY	7.3	8.5	16.6	67.6	27.1	5.5	6.9	57.5
AUG	1.2	5.6	19.0	74.2	12.6	9.3	22.3	55.9

DAYS WITH SPECIFIED WEATHER

MONTH	RAIN OR PCPN	DRIZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	SOBS WITH PCPN	NO OF OBS
JULY	21	21	0	0	29	0	0	0	30	10.4	247
AUG	29	29	0	0	10	5	0	0	31	25.8	248

** VV-90-93 AND/OR N=8 — COMP OB DAYS=COMPLETE OB DAYS

Wind

JULY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	.0	1.0	.3	.0	.0	1.3	17.4
NE	.8	2.9	2.1	.0	.0	.0	5.9	9.7
E	.8	3.0	2.0	.3	.0	.0	6.2	10.8
SE	.9	7.2	7.0	.1	.0	.0	15.1	10.4
S	1.0	6.4	8.6	.9	.0	.0	16.9	12.1
SW	.9	7.5	14.7	4.0	.3	.0	27.8	14.6
W	1.0	4.6	8.6	1.0	.0	.0	15.2	12.9
NW	.9	1.8	5.4	1.7	.0	.0	9.8	15.5
CALM	4.9	.0	.0	.0	.0	.0	4.9	.0
TOTAL	12.3	33.2	47.4	8.9	.0	.0	100.0	12.3

NUMBER OF OBS 247 — MAX WIND DIR 320 — SPEED 29 — DA HR 07 2100 — VECTOR SPEED 9.5 — MEAN DIR 222 — (DIR IN DEGREES)

AUG — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.7	4.2	1.1	.8	.0	.0	6.9	11.2
NE	.8	1.7	2.6	.0	.0	.0	5.3	12.6
E	.0	.3	1.0	1.1	.0	.0	2.4	18.8
SE	.4	1.6	3.7	.9	.0	.0	6.3	13.1
S	1.2	5.8	8.3	4.8	.7	.0	20.9	13.5
SW	.8	7.7	18.0	11.6	.9	.0	37.6	17.3
W	.8	1.3	3.2	3.2	2.2	.8	14.2	22.6
NW	.3	1.7	2.3	2.3	.8	.0	7.1	17.7
CALM	.4	.0	.0	.0	.0	.0	.4	.0
TOTAL	3.2	24.6	42.3	26.6	3.2	.0	100.0	16.8

NUMBER OF OBS 248 — MAX WIND DIR 250 — SPEED 44 — DA HR 28 0600 — VECTOR SPEED 10.0 — MEAN DIR 228 — (DIR IN DEGREES)

Wave

JULY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	.6	1.0	.0	.0	.0	.0	.0	1.6
NE	.4	.6	.5	.4	.0	.0	.0	.0	1.9
E	.3	2.7	.3	.0	.0	.0	.0	.0	3.8
SE	7.5	4.9	2.0	.8	.0	.0	.0	.0	10.2
S	1.2	3.9	4.8	2.3	.0	.0	.0	.0	11.0
SW	.4	3.6	10.2	.9	.0	.0	.0	.0	15.4
W	.6	4.0	8.3	5.6	.0	.0	.0	.0	18.1
NW	.4	3.3	6.1	3.7	.0	.0	.0	.0	13.6
IND	6.3	10.6	2.4	.8	.0	.0	.0	.0	23.9
CALM	.0	.0	.3	.0	.0	.0	.0	.0	.3
TOTAL	11.7	38.1	35.6	14.6	.0	.0	.0	.0	100.0

NUMBER OF OBS 247 — IND=INDETERMINATE

AUG — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.4	3.8	1.1	.0	.4	.0	.0	.0	5.9
NE	.0	2.7	.4	.0	.0	.0	.0	.0	3.1
E	.0	.8	1.3	.0	.0	.0	.0	.0	1.8
SE	.0	1.8	2.7	.0	.0	.0	.0	.0	4.0
S	.4	5.1	7.9	1.4	.4	.0	.0	.0	15.2
SW	.8	14.1	14.6	5.1	1.1	.0	.0	.0	35.8
W	1.0	3.2	1.8	2.3	4.7	1.2	.0	.0	17.0
NW	.0	3.7	2.2	1.2	1.4	.8	.0	.0	8.6
IND	.4	8.1	.4	.0	.0	.0	.0	.0	8.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	3.0	44.4	32.7	10.1	8.1	1.2	.0	.0	100.0

NUMBER OF OBS 248 — IND=INDETERMINATE

JULY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	9.3	15.8	3.7	.4	.0	.0	.0	.0	29.1
6-7	.0	4.5	21.1	9.1	.0	.0	.0	.0	34.9
8-9	.0	1.7	3.4	5.3	.0	.0	.0	.0	10.1
10-11	.0	.0	.8	.0	.0	.0	.0	.0	.8
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	6.3	10.6	2.4	.8	.0	.0	.0	.0	23.9
TOTAL	11.7	38.1	35.6	14.6	.0	.0	.0	.0	100.0

NUMBER OF OBS 247 — MGT 8.5 — MAX WAVE HEIGHT PER 9 — DIR 240 — TYPE Swl — DA HR 06 12 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

AUG — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	2.4	21.0	8.1	.4	.8	.0	.0	.0	31.9
6-7	.8	13.3	19.0	6.0	3.6	.0	.0	.0	42.7
8-9	.0	2.0	9.2	3.6	4.0	1.2	.0	.0	10.1
10-11	.0	.0	.4	.0	.4	.0	.0	.0	.4
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.4	8.1	.4	.0	.0	.0	.0	.0	8.9
TOTAL	3.6	44.4	32.7	10.1	8.1	1.2	.0	.0	100.0

NUMBER OF OBS 248 — MGT 6.9 — MAX WAVE HEIGHT PER 9 — DIR 280 — TYPE SEa — DA HR 28 12 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 5
CLIMATOLOGICAL DATA

Ocean Weather Station 'DELTA' 44°00'N 41°00'W — July and August, 1972

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JULY	13.7	19 21	20.5	26.2	10 18	8.3	14 00	17.0	21.7	*31 09	16.1	*09 12	21.8	24.4	16 03	- 7.5	*17 03	- 1.3	4.2	06 15
AUG	17.2	28 12	21.3	25.0	*17 18	9.9	28 12	17.4	22.4	15 15	19.9	08 06	22.0	23.8	15 00	- 4.6	** 12	- .7	4.2	17 21

MEANS AND EXTREMES — PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) — DAYS WITH SPECIFIED WEATHER

MONTH	PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	RAIN OR PCPN	DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	%OBS WITH PCPN	NO OF OBS
JULY	997.8	24 21	1018.6	1029.9	11 15	23.0	22.5	29.3	25.1	37.7	23.0	23.0	16.3	14	14	0	0	1	1	0	0	19	8.9	191
AUG	1006.8	27 09	1021.9	1030.0	*14 00	13.7	29.4	31.9	23.0	35.9	35.1	17.3	11.7	16	16	0	0	3	4	0	0	31	9.3	248

** VV-90-93 AND/OR W-4 — COMP OB DAYS-COMPLETE OB DAYS

Wind

JULY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.0	2.6	6.7	.0	.0	.0	9.3	12.0
NE	.0	7.2	6.3	.0	.0	.0	13.5	9.4
E	.0	2.1	7.3	.5	.0	.0	9.9	13.0
SE	.0	1.7	2.4	.5	.0	.0	4.6	12.7
S	.5	3.3	5.0	5.2	.0	.0	14.0	16.5
SW	.5	8.9	14.7	2.2	.0	.0	26.3	12.7
W	1.6	5.4	5.2	1.5	.0	.0	13.5	11.9
NW	1.0	2.4	4.3	.1	.0	.0	7.9	11.1
CALM	1.0	.0	.0	.0	.0	.0	1.0	.0
TOTAL	4.7	33.5	51.8	9.9	.0	.0	100.0	12.5

NUMBER OF OBS 191 — MAX WIND DIR 210 — SPEED 40 — DA HR 31 2359 — VECTOR SPEED 9.2 — MEAN DIR 214 — (DIR IN DEGREES)

AUG — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	1.1	3.5	1.2	.3	.0	.0	6.1	7.7
NE	.4	4.2	3.3	2.1	.0	.0	10.1	13.6
E	1.2	2.5	.7	.0	.0	.0	4.4	8.5
SE	1.6	4.0	3.3	.2	.0	.0	10.2	8.3
S	1.1	6.1	9.8	2.5	1.2	.0	20.8	14.7
SW	.1	5.6	9.5	3.0	.4	.0	18.9	15.1
W	.0	3.2	7.4	7.1	.4	.0	18.5	19.3
NW	.5	1.9	4.5	2.1	.0	.0	9.1	13.2
CALM	2.4	.0	.0	.0	.0	.0	2.4	.0
TOTAL	8.5	33.5	38.7	17.3	2.0	.0	100.0	13.9

NUMBER OF OBS 248 — MAX WIND DIR 210 — SPEED 40 — DA HR 01 0000 — VECTOR SPEED 5.6 — MEAN DIR 235 — (DIR IN DEGREES)

Wave

JULY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	4.2	6.5	.8	.0	.0	.0	.0	.0	11.5
NE	1.6	5.9	4.5	.0	.0	.0	.0	.0	12.0
E	2.1	2.1	2.7	.0	.0	.0	.0	.0	6.9
SE	1.7	1.6	.0	.0	.0	.0	.0	.0	3.3
S	1.7	2.9	0.2	.9	.0	.0	.0	.0	11.6
SW	10.2	17.2	9.2	.1	.0	.0	.0	.0	31.7
W	9.1	0.2	1.4	.0	.0	.0	.0	.0	14.8
NW	1.7	3.0	2.4	.0	.0	.0	.0	.0	7.1
IND	.0	1.0	.0	.0	.0	.0	.0	.0	1.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	28.3	43.5	27.2	1.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 191 — IND=INDETERMINATE

AUG — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	3.5	1.9	.4	.0	.0	.0	.0	5.8
NE	.0	3.8	2.8	.0	.0	.0	.0	.0	6.7
E	.0	6.9	2.3	.0	.0	.0	.0	.0	9.2
SE	.0	3.5	1.1	.1	.0	.0	.0	.0	4.8
S	.0	10.5	4.5	1.9	.0	.0	.0	.0	16.9
SW	.0	9.4	3.4	.5	.8	.0	.0	.0	14.1
W	.0	7.8	8.3	4.6	1.6	.0	.0	.0	22.3
NW	.0	1.8	3.4	1.7	.0	.0	.0	.0	9.0
IND	.0	8.5	.4	.4	.0	.0	.0	.0	9.3
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.0	57.7	30.2	9.7	2.4	.0	.0	.0	100.0

NUMBER OF OBS 248 — IND=INDETERMINATE

JULY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	28.7	22.5	9.4	.3	.0	.0	.0	.0	58.6
6-7	2.1	7.3	11.0	.5	.0	.0	.0	.0	20.9
8-9	.0	13.6	0.8	.0	.0	.0	.0	.0	19.4
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	1.0	.0	.0	.0	.0	.0	.0	1.0
TOTAL	28.3	43.5	27.2	1.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 191 — MAX WAVE HEIGHT HGT 9.0 — PER 7 — DIR 200 — TYPE SEA — DA HR 24 21 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

AUG — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	.0	23.4	8.5	.8	1.2	.0	.0	.0	33.1
6-7	.0	21.0	19.0	8.5	1.2	.0	.0	.0	49.6
8-9	.0	2.8	2.4	.8	.0	.0	.0	.0	6.0
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	8.3	.4	.4	.0	.0	.0	.0	9.3
TOTAL	.0	57.7	30.2	9.7	2.4	.0	.0	.0	100.0

NUMBER OF OBS 248 — MAX WAVE HEIGHT HGT 4.9 — PER 7 — DIR 270 — TYPE SEA — DA HR 02 09 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 6

CLIMATOLOGICAL DATA

Ocean Weather Station 'ECHO' 35°00'N 48°00'W — July and August, 1972

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JULY	22.2	20 09	24.7	26.4	29 15	10.4	22 09	21.0	24.7	*29 21	22.2	08 06	24.9	27.2	31 15	- 2.6	20 09	- .2	1.8	*26 18
AUG	23.5	12 09	25.6	29.0	30 18	18.7	09 15	22.1	23.4	*30 06	24.4	01 12	26.3	28.0	*31 03	- 3.7	29 00	- .8	1.4	02 18

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL PCPN	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	SOBS WITH PCPN	NO OF OBS
JULY	1009.4	20 09	1022.1	1036.0	*11 15	34.2	25.3	25.3	15.3	55.5	28.9	11.1	4.7	15	13	0	0	1	1	0	0	23	6.3	190
AUG	1013.6	27 06	1023.4	1029.1	14 00	37.8	41.8	18.4	2.0	63.8	33.2	2.6	.5	15	14	0	2	0	0	0	0	22	3.1	196

** VV-90-93 AND/OR W-4 COMP OB DAYS-COMPLETE OB DAYS

Wind

JULY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.4	9.7	8.7	.0	.0	.0	10.8	11.4
NE	1.2	.9	1.7	.0	.0	.0	3.8	7.8
E	2.6	2.5	.0	.0	.0	.0	5.3	3.7
SE	1.4	1.6	.0	.0	.0	.0	3.2	4.2
S	.5	.5	8.9	2.0	.0	.0	12.0	15.3
SW	.1	7.9	20.8	3.4	.9	.0	32.8	14.6
W	1.4	6.4	7.5	1.4	.0	.0	16.8	11.0
NW	.0	2.6	9.1	.0	.0	.0	11.7	12.7
CALM	3.7	.0	.0	.0	.0	.0	3.7	.0
TOTAL	11.6	26.3	54.7	6.8	.9	.0	100.0	12.0

NUMBER OF OBS 190 — MAX WIND DIR 240, SPEED 35, DA HR *22 1800 — VECTOR SPEED 6.3, MEAN DIR 249 (DIR IN DEGREES)

AUG — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.5	.5	.0	.0	.0	.0	1.0	9.5
NE	.0	.5	.0	.0	.0	.0	.5	9.5
E	.0	5.5	2.0	.0	.0	.0	7.5	9.2
SE	.0	5.5	2.0	.0	.0	.0	7.5	9.3
S	.9	4.5	7.3	.0	.0	.0	12.8	11.4
SW	.5	4.0	25.4	1.5	.5	.0	31.9	14.2
W	1.0	14.0	15.1	.0	.0	.0	29.1	10.0
NW	1.0	6.5	.1	.0	.0	.0	7.6	9.8
CALM	6.6	.0	.0	.0	.0	.0	6.6	.0
TOTAL	10.7	40.8	46.9	1.5	.0	.0	100.0	10.0

NUMBER OF OBS 196 — MAX WIND DIR 260, SPEED 31, DA HR 27 1000 — VECTOR SPEED 9.6, MEAN DIR 226 (DIR IN DEGREES)

Wave

JULY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	4.2	1.6	.0	.0	.0	.0	.0	6.4
NE	.0	3.3	4.2	.0	.0	.0	.0	.0	7.5
E	.5	.4	.0	.0	.0	.0	.0	.0	.9
SE	.5	11.2	.0	.0	.0	.0	.0	.0	11.7
S	1.8	7.1	3.4	.9	.0	.0	.0	.0	12.4
SW	.3	7.5	10.0	1.1	.5	.0	.0	.0	19.3
W	.9	18.0	7.6	1.6	.3	.0	.0	.0	28.3
NW	.5	12.4	.0	.0	.0	.0	.0	.0	12.9
IND	.9	.5	.0	.0	.0	.0	.0	.0	.5
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	4.2	65.3	26.8	2.6	1.1	.7	.0	.0	100.0

NUMBER OF OBS 190 — IND=INDETERMINATE

AUG — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.0	5.5	.0	.0	.0	.0	.0	.0	5.5
NE	.1	4.6	.0	.0	.0	.0	.0	.0	4.7
E	1.9	1.9	.0	.0	.0	.0	.0	.0	3.8
SE	.3	2.7	.0	.0	.0	.0	.0	.0	3.2
S	.9	4.7	1.3	.0	.0	.0	.0	.0	6.9
SW	.8	13.2	2.0	.0	.0	.0	.0	.0	17.9
W	4.6	17.1	8.9	.5	.0	.0	.0	.0	31.1
NW	.0	3.0	.0	.0	.0	.0	.0	.0	3.0
IND	2.8	17.9	1.3	.0	.0	.0	.0	.0	21.9
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	11.2	74.5	13.8	.5	.0	.0	.0	.0	100.0

NUMBER OF OBS 196 — IND=INDETERMINATE

JULY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	3.2	37.4	.5	.0	.0	.0	.0	.0	41.1
6-7	1.1	27.4	24.7	.5	.0	.0	.0	.0	53.7
8-9	.0	.0	1.6	2.1	1.1	.0	.0	.0	4.7
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.5	.0	.0	.0	.0	.0	.0	.5
TOTAL	4.2	65.3	26.8	2.6	1.1	.0	.0	.0	100.0

NUMBER OF OBS 190 — MAX WAVE HEIGHT HGT 4.5, PER 8, DIR 240, TYPE SEA, DA HR 22 18 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

AUG — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	8.7	32.1	.5	.0	.0	.0	.0	.0	41.3
6-7	.0	18.3	8.7	.0	.0	.0	.0	.0	29.0
8-9	.0	8.2	3.1	.5	.0	.0	.0	.0	11.7
10-11	.0	.0	.0	.0	.0	.0	.0	.0	.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	2.8	17.9	1.3	.0	.0	.0	.0	.0	21.9
TOTAL	11.2	74.5	13.8	.5	.0	.0	.0	.0	100.0

NUMBER OF OBS 196 — MAX WAVE HEIGHT HGT 3.5, PER 8, DIR 280, TYPE SWL, DA HR 23 12 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 7
Selected Gale Observations, North Atlantic
July and August 1972

Vessel	Nationality	Date	Position of Ship		Time GMT	Wind		Visibility	Present Weather code	Pressure mb	Temperature °C		Sea Waves+		Swell Waves		
			Lat. deg.	Long. deg.		Dir. 10°	Speed kt.				Air	Sea	Period sec	Height ft	Dir. 10°	Period sec	Height ft
NORTH ATLANTIC		JULY															
SS JOSEPH LYKES	AMERICAN	13	36.5 N	02.4 W	06	07 M	35	10 NM	02	1018.8	21.1	22.8	3	6.5	06	7	10
SS SEATRAIN CAROLINA	AMERICAN	21	45.0 N	33.1 W	18	07	38	5 NM	64	1007.3	17.8	20.0	4	8	07	7	16.5
SS AMER LANCER	AMERICAN	21	14.1 N	77.4 W	12	07	35	10 NM	02	1010.0	27.3	25.0	3	8	09	7	10
SS NORTHFIELD	AMERICAN	25	14.3 N	68.5 W	12	07	38	5 NM	01	1015.2	26.7	28.8			06	>13	16.5
SS ESSO JAMESTOWN	AMERICAN	26	13.1 N	75.2 W	18	07	33	5 NM	02	1010.0	28.5	27.8	6	10	07	10	16.5
SS ERIC K HOLZER	AMERICAN	26	34.3 N	71.5 W	18	26	35	5 NM	02	1017.3	29.8	25.6	5	10			
SS ESSO NEW ORLEANS	AMERICAN	27	34.3 N	74.6 W	00	24	40	5 NM	01	1016.6	29.0	29.7	5	10			
SS DOCTOR LYKES	AMERICAN	27	39.0 N	53.0 W	06	20 M	36	10 NM	15	1012.1	24.4	22.2	5	6.5	20	9	6.5
SS AMER LEGACY	AMERICAN	29	49.8 N	29.2 W	06	20	35	5 NM	01	1013.3	15.6	16.2	3	8	18	6	13
SS DOCTOR LYKES	AMERICAN	29	31.8 N	68.3 W	00	24 M	40	5 NM	81	1018.0	25.0	25.6	4	5	27	8	8.5
SS SEATRAIN FLORIDA	AMERICAN	30	14.3 N	77.4 W	18	09	35	5 NM	02	1011.9	27.8	28.9					
MV VEMA R/V	PANAMANIAN	30	34.1 N	17.4 W	18	32	40	5 NM	02	1013.3	12.0	12.4	5	10	31	8	19.5
SS AMER LIBERTY	AMERICAN	30	13.2 N	77.8 W	18	07	35	5 NM	02	1008.7	27.2	26.2	3	6.5	07	7	11.5
USNS NORWALK T-AK 279	AMERICAN	31	38.0 N	50.3 W	12	21	35	5 NM	03	1014.0	26.1	25.3	3	10			
SS SEATRAIN FLORIDA	AMERICAN	31	15.7 N	77.2 W	00	10	35	5 NM	03	1010.8	27.0	29.0	8	19.5			
SS AMER LIBERTY	AMERICAN	31	15.0 N	76.9 W	00	08	35	10 NM	01	1010.2	26.7	26.7	5	6.5	08	9	14.5
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC BOUTWELL	AMERICAN	14	56.5 N	51.0 W	12	24 M	38	2 NM	10	992.5	6.2	6.0	7	11.5			
ATLANTIC E																	
USCGC CHAUTAUQUA	AMERICAN	22	35.0 N	48.0 W	18	24 M	35	10 NM	15	1010.4	24.8	24.4	8	13			
GREAT LAKES VESSELS																	
SS PAUL H CARNAHAN	AMERICAN	2	43.0 N	87.5 W	06	35 M	54	2 NM	18		19.4	13.3					
SS JOHN SHERWIN	AMERICAN	15	41.9 N	81.8 W	12	21 M	35	5 NM	17		24.0	19.0	5	10			
NORTH ATLANTIC		AUG.															
SS BOSTON	AMERICAN	3	26.3 N	68.9 W	06	02	35	10 NM	01	1015.2	26.7	28.3					
SS SL 181	AMERICAN	7	47.8 N	13.1 W	18	23 M	38	5 NM	80	995.3	22.2	16.7	7	8	28	10	10
SS ESSO LIMA	AMERICAN	8	34.9 N	73.3 W	12	23 M	40	5 NM	05	1013.9	26.8	28.8	9	8			
SS ESSO PUERTO RICO	PANAMANIAN	15	27.7 N	70.5 W	06	16 M	42	5 NM	17	1015.6	24.2	27.7	4	5			
USCGC HAMILTON	AMERICAN	16	43.1 N	50.0 W	09	36	35	5 NM	21	1007.6	15.4	20.0	8	11.5			
SS AMER LEADER	AMERICAN	17	44.4 N	52.6 W	18	29	35	10 NM	02	1015.9	14.4	15.0	2	5	20	>13	11.5
USCGC MUNRO	AMERICAN	18	43.7 N	43.4 W	00	19 M	37	5 NM	03	1020.2	23.2	22.2	8	11.5			
SS AMER LEGACY	AMERICAN	27	49.5 N	42.5 W	00	20	35	2 NM	23	1003.0	14.5	17.0	5	8			
SS HUEGH TRANSPORTER	NORWEGIAN	30	43.3 N	32.3 W	12	07	40 (B)	5 NM	52	1016.0	24.0	25.0	7	13			
SS HESS VOYAGER	AMERICAN	31	30.7 N	79.5 W	00	03	35	1 NM	82	1012.5	28.0	29.4	4	6.5			
OCEAN STATION VESSELS																	
ATLANTIC B																	
USCGC INGHAM	AMERICAN	22	55.9 N	30.2 W	06	19 M	35	5 NM	02	996.4	10.2	8.8	8	14.5			
USCGC INGHAM	AMERICAN	26	55.6 N	30.0 W	18	21 M	38	2 NM	61	991.9	8.9	8.8	6	11.5			
USCGC INGHAM	AMERICAN	27	55.2 N	30.7 W	06	29 M	30	2 NM	28	992.1	5.8	7.8	10	26			
ATLANTIC C																	
USCGC SHERMAN	AMERICAN	10	52.6 N	35.7 W	21	28 M	40	2 NM	61	1003.6	10.9	11.1	7	10.5			
USCGC SHERMAN	AMERICAN	18	52.6 N	35.6 W	06	20 M	35	5 NM	61	1014.1	14.3	11.7	8	10			
USCGC SHERMAN	AMERICAN	27	52.7 N	35.6 W	21	26 M	37	10 NM	25	1002.3	10.3	11.1	7	13			
USCGC SHERMAN	AMERICAN	28	52.7 N	35.5 W	06	25 M	44	10 NM	80	1003.3	9.3	11.7	10	16.5			
ATLANTIC D																	
USCGC MUNRO	AMERICAN	1	44.0 N	41.0 W	00	21 M	40	200 YD	65	1013.5	21.4	22.0	5	13			
USCGC MUNRO	AMERICAN	17	43.9 N	42.6 W	12	18 M	36	10 NM	02	1021.5	24.0	22.1	7	10			
GREAT LAKES VESSELS																	
SS LEON FALK JR	AMERICAN	3	42.3 N	80.8 W	02	24 M	42	50 YD	82		22.0		3	3			

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind
(B) Hurricane Betty

NOTE: These observations are selected from those with winds of 35 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 3-hr observations. In a good many cases, the maximum wind speeds given in the U.S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Table 8
U.S. Ocean Station Vessel Climatological Data
North Pacific

Ocean Weather Station 'NOVEMBER' 30°00'N 140°00'W **July and August, 1972**

MEANS AND EXTREMES

MONTH	DRY BULB TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	DEW-POINT TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	SEA TEMP (°C) MIN	DA HR	MEAN	MAX	DA HR	AIR-SEA TEMP DIFFERENCE (°C) MIN	DA HR	MEAN	MAX	DA HR
JULY	18.6	•20 15	20.2	22.2	30 21	11.9	22 12	16.3	19.7	30 03	20.0	•04 15	21.3	22.5	•31 03	- 3.3	•29 12	- 1.2	.9	•02 21
AUG	19.1	01 12	22.1	24.4	20 05	13.4	06 09	17.8	20.6	22 15	21.2	•08 09	22.7	25.6	•14 00	- 3.9	16 12	- .6	1.8	08 15

MONTH	MEANS AND EXTREMES PRESSURE (MB) MIN	DA HR	MEAN	MAX	DA HR	PERCENTAGE FREQUENCY OF CLOUD AMOUNT (OKTAS) TOTAL CLOUD 0-2	3-5	6-7	8 & OBSC	LOW CLOUD 0-2	3-5	6-7	8 & OBSC	DAYS WITH SPECIFIED WEATHER RAIN OR DRZL	SNOW	TSTM	VSBY <1KM **	WIND (KTS) ≥34	≥48	≥64	COMP OB DAYS	SCHS WITH PCPN	NO OF OBS
JULY	1015.9	19 03	1021.6	1028.1	11 18	3.9	21.9	47.8	26.7	8.1	27.9	37.7	26.3	12	12	0	0	0	0	0	30	1.8	247
AUG	1014.3	20 03	1019.5	1023.7	•17 21	19.1	25.3	33.8	21.8	24.0	28.9	28.0	18.2	11	11	0	0	0	0	0	28	6.7	225

** VT=SD-S2 ABS/OR R=4 COMP OB DATE-COMPLETE OB DATE

Wind

JULY — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.3	1.1	3.7	.0	.0	.0	5.2	12.6
NE	.1	23.0	46.9	.4	.0	.0	70.5	12.0
E	.0	10.5	10.9	.0	.0	.0	21.5	10.9
SE	.0	1.7	.8	.0	.0	.0	2.5	9.4
S	.4	.0	.0	.0	.0	.0	.4	3.0
SW	.0	.0	.0	.0	.0	.0	.0	.0
W	.0	.0	.0	.0	.0	.0	.0	.0
NW	.0	.1	.0	.0	.0	.0	.1	4.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	.8	36.4	62.3	.4	.0	.0	100.0	11.7

NUMBER OF OBS 247 — MAX WIND DIR 050, SPEED 22, DA HR 13 0300 — VECTOR SPEED 10.9, MEAN DIR 053 (DIR IN DEGREES)

AUG — WIND DIRECTIONS AND SPEEDS (% FREQUENCIES)

DIR	WIND SPEED (KNOTS) <4	4-10	11-21	22-33	34-47	>47	TOTAL	MEAN SPEED
N	.8	2.2	.8	.0	.0	.0	3.2	7.2
NE	.4	6.1	17.9	.9	.0	.0	25.3	12.9
E	2.1	21.4	26.2	.0	.0	.0	49.8	11.3
SE	1.4	5.3	3.0	.4	.0	.0	10.2	9.7
S	.0	.0	.4	.0	.0	.0	.4	12.0
SW	.0	1.3	.0	.0	.0	.0	1.3	9.3
W	.4	2.0	.3	.0	.0	.0	2.8	7.4
NW	.0	2.4	.3	.0	.0	.0	2.8	9.9
CALM	3.3	.0	.0	.0	.0	.0	3.3	.0
TOTAL	9.8	40.9	48.8	1.3	.0	.0	100.0	10.8

NUMBER OF OBS 223 — MAX WIND DIR 030, SPEED 35, DA HR 21 1200 — VECTOR SPEED 8.7, MEAN DIR 075 (DIR IN DEGREES)

Wave

JULY — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	.3	17.0	.8	.0	.0	.0	.0	.0	18.9
NE	3.8	52.8	6.0	.0	.0	.0	.0	.0	62.7
E	1.1	13.1	.9	.0	.0	.0	.0	.0	15.1
SE	.4	2.9	.0	.0	.0	.0	.0	.0	3.3
S	.0	.0	.0	.0	.0	.0	.0	.0	.0
SW	.0	.0	.0	.0	.0	.0	.0	.0	.0
W	.0	.0	.0	.0	.0	.0	.0	.0	.0
NW	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	.0	.0	.0	.0	.0	.0	.0
CALM	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	5.7	85.8	7.7	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 247 — IND=INDETERMINATE

AUG — WAVE DIRECTIONS AND HEIGHTS (% FREQUENCIES)

DIR	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
N	1.0	.0	.0	.0	.0	.0	.0	.0	1.0
NE	6.0	17.0	1.1	.0	.0	.0	.0	.0	24.0
E	9.2	44.6	1.0	.0	.0	.0	.0	.0	54.8
SE	3.0	4.7	.1	.0	.0	.0	.0	.0	7.8
S	.4	3.1	.0	.0	.0	.0	.0	.0	3.6
SW	.4	.4	.0	.0	.0	.0	.0	.0	.9
W	2.3	.0	.0	.0	.0	.0	.0	.0	2.3
NW	2.1	2.2	.0	.0	.0	.0	.0	.0	4.4
IND	.0	.0	.0	.0	.0	.0	.0	.0	.0
CALM	.4	.0	.0	.0	.0	.0	.0	.0	.4
TOTAL	25.0	72.0	2.2	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 224 — IND=INDETERMINATE

JULY — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	4.9	60.7	3.6	.0	.0	.0	.0	.0	69.2
6-7	.8	17.0	4.0	.0	.0	.0	.0	.0	21.1
8-9	.8	8.9	.0	.0	.0	.0	.0	.0	9.7
10-11	.8	.0	.0	.0	.0	.0	.0	.0	.8
12-13	.8	.0	.0	.0	.0	.0	.0	.0	.8
>13	.8	.0	.0	.0	.0	.0	.0	.0	.8
IND	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	9.7	86.6	7.7	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 247 — MAX WAVE HEIGHT HGT 2.8, PER 9, DIR 090, TYPE SEA, DA HR 13 21 — IND=INDETERMINATE (DIR IN DEGREES)

*ALSO OCCURRED ON PREVIOUS OBSERVATIONS

AUG — WAVE PERIODS AND HEIGHTS (% FREQUENCIES)

PERIOD IN SECONDS	WAVE HEIGHT (METERS) <1	1-1.5	2-2.5	3-3.5	4-5.5	6-7.5	8-9.5	>9.5	TOTAL
<6	23.7	46.0	1.3	.0	.0	.0	.0	.0	71.0
6-7	.4	11.2	.9	.0	.0	.0	.0	.0	12.9
8-9	.9	11.6	.0	.0	.0	.0	.0	.0	12.9
10-11	.0	4.0	.0	.0	.0	.0	.0	.0	4.0
12-13	.0	.0	.0	.0	.0	.0	.0	.0	.0
>13	.0	.0	.0	.0	.0	.0	.0	.0	.0
IND	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL	25.0	72.8	2.2	.0	.0	.0	.0	.0	100.0

NUMBER OF OBS 224 — MAX WAVE HEIGHT HGT 3.0, PER 6, DIR 070, TYPE SWL, DA HR 14 00 — IND=INDETERMINATE (DIR IN DEGREES)

For each observation, the higher wave of the sea/swell group was selected for summarization; if heights were equal, the wave with the longer period was selected; if periods were also equal, the sea wave was used.

Table 9
Selected Gale Observations, North Pacific
July and August 1972

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10's	Wind Speed kt	Visibility	Present Weather code	Pressure mb	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec	Sea Waves* Height ft	Swell Waves Dir. 10's	Swell Waves Period sec	Swell Waves Height ft
NORTH PACIFIC		JULY															
SS PACIFIC BEAR	AMERICAN	1	38.0 N	126.5 W	12	33	N 37	10 NM	02	1011.9	15.3	14.4	4	8	33	10	11.5
USCGC GLACIER	AMERICAN	1	42.3 N	125.3 W	12	02	M 42	5 NM	02	1014.0	14.6	12.7	7	8			
SS MONTEREY	AMERICAN	2	41.9 N	124.7 W	00	02	36	10 NM	01	1011.5	14.3	12.2	4	8			
SS GUAM BEAR	AMERICAN	2	39.1 N	130.9 W	12	35	40	10 NM	02	1017.3	13.9	14.6	6	10	05	6	10
SS SANTA MARIANA	AMERICAN	5	13.7 N	94.9 W	18	36	35	10 NM	02	1012.2	29.4	29.4	5	5			
SS MARYMAR	AMERICAN	7	14.2 N	95.6 W	12	05	40	10 NM	02	1011.2	29.0	30.0	5	6.5	05	< 6	10
SS PRES VAN BUREN	AMERICAN	8	36.4 N	146.0 E	18	22	35	10 NM	02	1007.0	23.9	23.9	3	5	22	< 6	8
SS CONNECTICUT	AMERICAN	8	37.2 N	133.0 E	12	23	35	5 NM	02	1002.7	23.5	20.5	3	5	23	< 6	11.5
SS PRES LINCOLN	AMERICAN	10	46.0 N	164.3 W	18	27	35	5 NM	31	998.3	10.6	8.9	5	8	26	8	13
MV OCEAN PROSPER	LIBERIAN	11	42.2 N	151.9 W	00	22	38	.5 NM	60	1009.1	16.7	15.6			22	9	13
MV SALLY MAERSK	DANISH	12	25.0 N	149.9 E	18	09	35 (P)	10 NM	02	1005.0	28.5	29.0	8	11.5	09	12	13
SS STEEL ARTISAN	AMERICAN	12	15.2 N	134.6 E	06	01	35 (R)	1 NM		1004.4	25.5	28.4	8	10			
SS STEEL ARTISAN	AMERICAN	13	14.6 N	131.8 E	00	23	40 (R)	2 NM		1000.3	28.3	28.8	8	10	23	12	18
SS SEATRAIN LOUISIANA	AMERICAN	13	09.4 N	161.5 E	12	29	38 (T)	5 NM	25	1009.1	27.7	28.9	6	6.5	26	9	11.5
MV SALLY MAERSK	DANISH	13	25.4 N	150.9 E	00	11	40 (P)	10 NM	02	1008.0	29.0	29.0	8	11.5	11	12	13
MV VENNACHAR	BRITISH	13	27.3 N	150.2 E	06	13	37 (P)	5 NM	02	1004.0	31.0						
SS SEATRAIN GEORGIA	AMERICAN	14	38.4 N	126.3 W	00	30	35	1 NM	10	1016.6	16.3	16.3	3	6.5	30	6	10
SS SEATRAIN PUERTO RICO	AMERICAN	14	19.4 N	138.5 E	00	18	35 (R)	10 NM	18	999.7	28.3	29.8	4	6.5	23	11	19.5
SS SEATRAIN LOUISIANA	AMERICAN	14	09.1 N	155.1 E	18	25	35 (T)	10 NM	50	1007.1	27.2	28.9	5	6.5	25	10	11.5
MV SALLY MAERSK	DANISH	15	17.8 N	138.6 E	18	22	42 (R)	10 NM	02	994.0	28.5	28.0	7	10.5			
SS MOBILE	AMERICAN	15	51.6 N	130.1 W	18	35	35	10 NM	01	1030.8	13.7	11.7	5	6.5			
MV EFFIE MAERSK	DANISH	15	32.7 N	128.9 W	18	34	35	10 NM	03	1014.0	18.0	16.5	6	10			
SS GULFCREST	AMERICAN	15	21.4 N	136.5 W	12	09	35	10 NM	03	1012.5	24.4	25.0	7	5			
SS AMER RACER	AMERICAN	15	19.2 N	138.5 E	06	25	45 (R)	2 NM	84	995.3	25.3	24.4	7	19.5			
MV SALLY MAERSK	DANISH	16	15.5 N	133.8 E	12	23	40 (R)	10 NM	02	1000.0	28.0	28.0	7	10	22	10	16.5
MV ANDREAS U	NORWEGIAN	16	36.2 N	173.9 E	00	29	38	10 NM	02	1000.6	26.0	21.0	5	5			
MV VENNACHAR	BRITISH	16	18.9 N	140.5 E	06	20	38 (R)	10 NM	80	996.0	29.0						
MV VENNACHAR	BRITISH	17	16.7 N	138.2 E	00	21	40 (R)	10 NM	02	998.0	30.0						
SS ESSO WASHINGTON	AMERICAN	17	18.2 N	137.3 E	12	18	55 (R)	5 NM	03	1001.0	27.0	27.7					
MV SALLY MAERSK	DANISH	17	14.4 N	129.7 E	06	23	35 (R)	10 NM	02	1000.0	29.5	28.0	7	14.5	22	10	19.5
MV VENNACHAR	BRITISH	18	17.6 N	132.1 E	12	26	38 (R)	5 NM	50	996.0	26.0						
SS ELIZABETH LYKES	AMERICAN	18	18.4 N	134.7 E	00	23	35 (R)	5 NM	64	1002.2	26.7	27.2			23	>13	19.5
SS ESSO WASHINGTON	AMERICAN	18	17.5 N	133.6 E	06	20	55 (R)	5 NM	03	1001.0	27.5	26.7					
SS MOBILE	AMERICAN	18	52.0 N	131.7 W	18	32	35	5 NM	02	1028.4	12.7	13.7	5	6.5	31	9	11.5
SS ESSO WASHINGTON	AMERICAN	19	17.6 N	127.2 E	06	23	35 (R)	5 NM	03	1001.7	29.5	27.2	4	6.5			
SS ELIZABETH LYKES	AMERICAN	19	17.3 N	130.0 E	00	26	35 (R)	5 NM	64	1002.5	25.5	26.1	6	8	26	7	14.5
SS TRENTON	AMERICAN	19	30.2 N	129.5 E	12	05	55 (R)	2 NM		997.3	26.7	28.3	6	10	09	8	13
SS PIONEER CRUSADER	AMERICAN	19	26.6 N	152.2 E	00	13	50 (T)	5 NM	29	1000.5	26.7	27.2	4	19.5			
SS C E DANT	AMERICAN	20	49.0 N	177.6 E	12	13	35	1 NM	45	1018.0	9.4	7.8	3	10	13	6	13
SS LONG BEACH	AMERICAN	20	25.7 N	151.3 E	18	18	40 (T)	10 NM	51	1003.7	25.0	29.5					
SS HAWAII	AMERICAN	20	25.6 N	151.0 E	12	17	35 (T)	2 NM	02	1004.4	23.3	26.7	7	8	20	8	14.5
SS TRENTON	AMERICAN	20	30.4 N	130.1 E	00	04	60 (R)	1 NM	15	988.8	24.4	28.3	6	13	08	8	16.5
SS LONG BEACH	AMERICAN	21	24.5 N	150.5 E	00	17	40 (T)	10 NM	51	1003.4	23.9	27.2	3	13	19	>13	29.5
SS HAWAII	AMERICAN	21	25.7 N	147.5 E	00	16	35 (T)	5 NM	02	997.0	26.7	26.7	7	6.5	23	7	13
SS TRENTON	AMERICAN	21	31.9 N	132.3 E	00	10	50 (R)	2 NM	16	999.3	26.7	26.7			09	7	16.5
SS PHIL MAIL	AMERICAN	21	45.1 N	175.9 E	06	16	45	200 YD	41	1013.5	13.9	11.1	5	8			
SS COLORADO	AMERICAN	22	31.0 N	127.1 E	12	08	35 (R)	10 NM	02	999.7	23.5	24.5	5	8			
SS SEA TRAIN OHIO	AMERICAN	22	25.5 N	122.4 E	12	34	40 (R)	5 NM	64	993.9	26.6	28.9	4	8	34	8	14.5
SS PERRYVILLE	AMERICAN	22	33.3 N	136.2 E	12	07	50 (T)	5 NM	02	1001.4	23.0	26.7	8	31			
SS COLORADO	AMERICAN	23	27.9 N	127.6 E	00	09	35 (R)	10 NM	02	989.5	27.3	25.5	5	8			
SS INDIAN MAIL	AMERICAN	23	32.2 N	134.3 E	00	05	37 (T)	5 NM	03	987.5	26.7	23.9					
SS PERRYVILLE	AMERICAN	23	33.1 N	135.3 E	06	13	38 (T)	5 NM	02	1000.7	25.6	27.2	8	19.5	12	11	26
SS SEA TRAIN OHIO	AMERICAN	23	22.8 N	127.8 E	12	22	40 (R)	5 NM	64	989.2	26.6	28.8	3	11.5	22	10	16.5
SS PRES WILSON	AMERICAN	24	26.5 N	123.1 E	00	35	40 (R)	5 NM	02	993.2	26.4	27.5			36	7	16.5
SS PRES GRANT	AMERICAN	24	26.0 N	132.7 E	12	13	37 (R)	10 NM	03	997.0	25.0	25.0	4	13	26	12	21
SS AMER CHARGER	AMERICAN	24	21.0 N	124.0 E	00	25	35 (R)	10 NM	02	997.2	27.8	28.4					
SS HAWAII	AMERICAN	24	25.7 N	131.2 E	12	18	35 (R)	5 NM	02	995.6	26.7	28.9	7	8	18	7	16.5
SS COLORADO	AMERICAN	24	27.0 N	129.5 E	06	36	50 (R)	5 NM	02	983.1	24.5	25.6	9	21			
SS PRES WILSON	AMERICAN	25	26.5 N	129.5 E	00	18	35 (R)	1 NM	62	994.2	25.6	26.7	5	5	21	10	11.5
SS PRES GRANT	AMERICAN	25	23.8 N	130.6 E	00	19	35	10 NM	03		26.7	26.7	4	13	26	12	21
SS AMER LEGION	AMERICAN	25	28.0 N	123.5 E	06	32	38 (R)	5 NM	02	993.8	26.7	26.1					
SS AFRICAN COMET	AMERICAN	25	23.5 N	164.3 E	00	19	50 (V)	5 NM	02	1010.0	26.4	25.6	5	13			
SS COLORADO	AMERICAN	25	26.6 N	126.2 E	00	29	35 (R)	10 NM	60	988.2	25.6	23.8	6	10	36	6	11.5
SS HAWAII	AMERICAN	25	25.8 N	128.5 E	06	21	35 (R)	5 NM	02	994.5	26.7	28.9	6	8	23	10	16.5
NORTH PACIFIC		AUG.															
SS GUAM BEAR	AMERICAN	2	38.5 N	127.0 W	18	36	38	10 NM	02	1016.3	13.9	16.7	6	8	36	10	10
USCGC BITTERSWEET	AMERICAN	5	56.0 N	132.8 W	18	14	M 35	5 NM	02	1014.9	13.8	14.5					
USNS SILAS BENT	AMERICAN	6	53.2 N	141.2 W	06	22	M 44	5 NM	03	1019.1	13.9	11.2			19	8	5
SS ESSO NEWARK	AMERICAN	6	42.5 N	128.4 W	12	02	35	5 NM	02	1021.7	16.0	16.7	4	6.5	01	< 6	10
SS STEEL DESIGNER	AMERICAN	7	30.0 N	145.0 E	12	17	40 (A)	5 NM	02	1008.5	25.6	26.7	6	8	20	7	13
SS ORIENTAL PEARL	LIBERIAN	8	40.5 N	178.4 E	12	09	35	.5 NM	60	993.9	19.5	18.3	6	8	09	>13	19.5
MV PEARLSTONE	LIBERIAN	9	36.3 N	113.8 W	06	32	35	10 NM	00	1001.3	29.0	27.0					
SS SEATRAIN GEORGIA	AMERICAN	9	16.8 N	149.1 E	18	09	35 (B)	10 NM	02	1005.8	27.7	28.9					
SS ORIENTAL PEARL	LIBERIAN	9	40.5 N	174.4 W	12	15	35	2 NM	05	1007.8	20.0	19.0	6	10	15	>13	21
SS ORIENTAL PEARL	LIBERIAN	10	39.1 N	171.5 W	00	18	35	2 NM	05	1016.3	24.0	19.0	6	10	15	>13	19.5
SS MAECO	AMERICAN	10	15.5 N	149.3 E	06	18	35 (B)	10 NM	03	1006.1	28.8	28.8	9	14.5	18	>13	19.5
MV LA SALLE	AMERICAN	10	17.6 N	148.5 E	06	16	37 (B)	5 NM	00	1005.8	28.4	30.5	5	6.5	14	6	11.5
SS GOLDEN BEAR	AMERICAN	10	37.8 N	163.9 E	12	30	45	5 NM	01	1004.5	20.0	20.0					
SS MARINE FIDDLER	AMERICAN	10	19.0 N	126.0 W	00	07	35 (C+)	5 NM	10	1012.5	26.7	25.0	4	5	08	6	10
MV LA SALLE	AMERICAN	11	17.0 N	147.9 E	00	08	35 (B)	5 NM	62	1006.4	28.6	29.5	8	10	08	7	11.5
SS HASTINGS	AMERICAN	11	36.8 N	170.0 E	00	33	35	5 NM	01	1005.8	28.3	23.3	3	6.5	33	6	16.5
MV JAPAN CADRO	LIBERIAN	11	36.9 N	171.6 E	12	30	35	5 NM	03	1008.0	21.0	23.0					
USCGC MELLON	AMERICAN	13	17.2 N	126.2 W	21	08	M 45 (D+)	5 NM	61	1006.5	26.4	25.6	8	18			
USCGC MELLON	AMERICAN	14	17.2 N	126.0 W	03	10	M 38 (D+)	5 NM	61	1007.8	26.2	25.6	8	16.5			

Vessel	Nationality	Date	Position of Ship Lat. deg.	Position of Ship Long. deg.	Time GMT	Wind Dir. 10°	Wind Speed kt	Visibility	Present Weather code	Pressure mb	Temperature °C Air	Temperature °C Sea	Sea Waves* Period sec	Sea Waves* Height ft	Swell Waves Dir. 10°	Swell Waves Period sec	Swell Waves Height ft
NORTH PACIFIC OCEAN		AUG.															
SS MORMACGLEN	AMERICAN	14	17.6 N	134.0 E	12	16	35 (B)	5 NM	65	1003.7	27.0	29.4	5	13	18	>13	19.5
SS SPIRIT OF LIBERTY	AMERICAN	15	19.3 N	127.5 E	18	18	60 (B)	200 YD	65	992.9	26.7	30.0	8	41			
SS AMER CHALLENGER	AMERICAN	15	18.7 N	128.6 E	18	18	50 (B)	5 NM	02	999.0	27.8	28.9	6	10			
SS PRES ADAMS	AMERICAN	15	25.3 N	128.5 E	12	13	65 (B)	5 NM	02	997.3	26.7	27.8	2	13	14	6	19.5
SS PRES TYLER	AMERICAN	15	26.6 N	127.6 E	18	10	37 (B)	10 NM	15	999.0	26.7	27.8	6	10			
SS SPIRIT OF LIBERTY	AMERICAN	16	20.1 N	128.7 E	00	16	50 (B)	5 NM	03	999.7	27.2	27.8	8	23	36	>13	32.5
SS STEEL DESIGNER	AMERICAN	16	24.6 N	129.7 E	18	14	35 (B)	10 NM	02	1008.5	26.7	28.2					
SS MARYLAND TRADER	AMERICAN	16	20.6 N	122.6 E	12	27	35 (B)	2 NM	25	995.3	26.1	29.4	5	8	05	< 6	13
SS PRES TYLER	AMERICAN	16	26.8 N	127.8 E	06	14	45 (B)	2 NM	50	999.0	25.6	27.2	7	11.5			
SS AMER CHALLENGER	AMERICAN	16	19.0 N	130.5 E	00	18	45 (B)	5 NM	02	1004.5	26.7	28.9	8	19.5			
SS STEEL DESIGNER	AMERICAN	17	25.2 N	128.1 E	06	14	35 (B)	5 NM	02	1007.8	27.7	27.7	6	13			
SS ESSO SEATTLE	AMERICAN	17	22.4 N	126.5 E	06	14	35 (B)	5 NM	15	1006.2	26.0	29.4					
SS PRES ADAMS	AMERICAN	17	22.7 N	126.5 E	00	19	35 (B)	5 NM	02	1002.4	25.0	25.6	3	6.5	19	6	11.5
SS EXPORT COURIER	AMERICAN	17	26.0 N	129.0 E	00	12	40 (B)	2 NM	07	1008.5	27.5	26.8					
SS MARYLAND TRADER	AMERICAN	17	24.0 N	127.2 E	12	14	35 (B)	2 NM	25	1008.1	24.4	25.0	5	11.5	18	6	11.5
MV EASTERN GLORY	LIBERIAN	19	21.4 N	134.2 W	03	06	40(D*)	10 NM	15	1011.1	26.2	26.9	3	8	08	< 6	16.5
MV HENRIETTE W. SCHULTE	GERMAN	20	48.2 N	174.5 W	18	27	42	1 NM	03	1005.0	13.0	12.0	11	21			
SS AMER LANCER	AMERICAN	21	21.2 N	170.4 W	06	07	55(C*)	.5 NM	65	1004.8	24.4	25.6	9	10	14	X	24.5
SS STEEL ARTISAN	AMERICAN	21	13.7 N	96.5 W	18	09	45(G*)	5 NM	63	1011.5	25.2	29.4	6	8	09	10	10
SS PRES TAFT	AMERICAN	23	46.5 N	177.3 W	06	27	35	10 NM	03	1009.0	13.6	10.0			24	10	6.5
SS STEEL NAVIGATOR	AMERICAN	23	26.5 N	177.4 W	12	07	35	5 NM	02	1015.9	24.5	27.7	5	14.5			
MV EASTERN GLORY	LIBERIAN	24	20.1 N	128.2 W	21	05 M	52(F*)	2 NM	07	1001.8	28.4	29.8	5	19.5			
SS ROSE CITY	AMERICAN	24	41.2 N	182.8 W	00	30	35	5 NM	02	1012.8	18.4	20.5	7	10			
SS PIONEER CRUSADER	AMERICAN	24	40.3 N	158.4 W	06	28	35	10 NM	02	1013.7	17.8	21.1	7	11.5			
MV SANDAR	NORWEGIAN	24	44.8 N	157.9 W	12	31	35	5 NM	03	1007.6	13.5	16.0	6	8	30	10	14.5
MV WESER DISPATCHER	GERMAN	24	45.1 N	150.1 W	18	25	35	5 NM	81	999.5	16.0	17.0	6	19.5			
SS STEEL APPRENTICE	AMERICAN	24	13.5 N	122.0 W	18	21	45(F*)	10 NM	01	1008.5	27.8	26.1	9	10	33	12	13
SS PHIL MAIL	AMERICAN	25	49.3 N	133.1 W	12	16	40	5 NM	62	1010.8	16.1	16.1	5	8			
MV EASTERN GLORY	LIBERIAN	25	21.0 N	127.8 W	06	07 M	48(F*)	2 NM	07	1007.5	26.1	24.1	2	11.5			
MV HENRIETTE W. SCHULTE	GERMAN	27	37.7 N	146.5 E	06	25	40	5 NM	29	993.5	20.6	23.0	7	23			
SS THOMAS E CUFFE	AMERICAN	28	38.7 N	161.9 E	12	12 M	36 (D)	5 NM	02	1009.8	25.6	23.3					
SS HARRY LUNDEBERG	PANAMANIAN	28	24.3 N	111.9 W	12	14	35 (G*)	10 NM	03	1006.3	27.7	30.0	5	14.5			
SS MOBILE	AMERICAN	28	54.1 N	136.1 W	00	09	35	2 NM	21	1008.5	13.3	14.0					
MV WORLD CREST	LIBERIAN	29	42.7 N	160.3 E	07	11 M	48	1 NM	80	987.0	19.0	17.0	14	26			
USNS SILAS BENT	AMERICAN	29	54.4 N	175.7 W	06	28 M	40	5 NM	03	998.2	10.0	9.0	5	6.5	29	9	14.5
SS JAPAN MAIL	AMERICAN	29	50.0 N	158.8 W	06	27	35	.25 NM	47	1005.1	10.6	10.0	3	5	27	7	11.5
SS ROSE CITY	AMERICAN	29	39.9 N	161.9 E	00	12	35 (D)	5 NM	02	1001.7	21.1	22.2	9	10	12	8	13
SS THOMAS M	AMERICAN	30	12.9 N	101.0 W	06	11	45 (H*)	5 NM	60	1009.8	25.0	30.5	8	16.5			
USCGC CONFIDENCE	AMERICAN	30	52.9 N	168.8 W	12	32	40	.5 NM	28	1000.3	7.8	8.3					
MV EASTERN GLORY	LIBERIAN	30	13.0 N	100.3 W	05	12 M	38 (H*)	5 NM	01	1008.6	26.8	29.9	3	10			
SS PRES CLEVELAND	AMERICAN	31	23.2 N	153.6 W	06	14	40	5 NM	02	1006.4	25.0	25.6					

\+ Direction for sea waves same as wind direction
X Direction or period of waves indeterminate
M Measured wind

(A) Typhoon Alice
(B) Supertyphoon Betty
(D) Tropical storm Doris
(F) Typhoon Phyllis
(R) Supertyphoon Rita
(T) Supertyphoon Tess
(V) Tropical storm Viola
(C*) Hurricane Celeste
(D*) Hurricane Diana
(F*) Hurricane Fernanda
(G*) Hurricane Gwen
(H*) Hurricane Hyacinth

NOTE: These observations are selected from those with winds of 35 kt or higher. In cases where a ship reported more than one observation a day with such winds, the observation with the highest wind speed was selected. In cases where two or more observations had the same wind speed, the one at 1200 GMT or the one closest to 1200 GMT was chosen. If this method still did not break a tie, the one with the lowest barometric pressure was picked. The data for the Ocean Station Vessels are based on 2-hr observations. In a good many cases, the maximum wind speeds given in the U.S. Ocean Station Climatological Data tables are higher because these are based on the Summary of Day entries.

Rough Log, North Atlantic Weather

October and November 1972

ROUGH LOG, OCTOBER 1972--Cyclone activity and storm tracks were mainly concentrated in two areas. The first was across the southern part of Hudson Bay, predominantly James Bay, then eastward and northward up the Davis Strait. The second was up the U.S. East Coast, across Newfoundland, and through the Denmark Strait. A few weak LOWS developed and wandered about the central and eastern North Atlantic above 30°N. One storm tracked across lower Lake Michigan and Lake Erie prior to joining the main storm track up the East Coast.

The Bermuda-Azores High was more circular, rather than its normal elongated configuration, and within 1 mb of its climatological mean of 1022 mb. The center was located about 600 mi northwest of its mean position. The Icelandic Low, which climatologically is split into two Lows, one near Iceland and one in the Davis Strait, appeared as a closed system only in the Davis Strait and as a trough extending from the Pole southwestward to Iceland. The mean pressure of the Low in the Davis Strait was 1002 mb, 1 mb deeper than indicated by climatology. A shallow Low of 1013-mb pressure was noted off the west coast of Portugal. This was the end result of four migratory LOWS in that area, approximately one each week, three of which developed in the area.

The displacement of the Icelandic Low and northwesterly position of the Bermuda-Azores High resulted in a positive 9-mb anomaly centered near 55°N, 36°W. This ties in directly with the main storm tracks up both coasts of Greenland and a dearth of storm tracks across the Atlantic into Europe. The main negative anomalies were a 5-mb area off the Portuguese coast, another region of 5-mb near Baffin Island, and a 2-mb area in the central Atlantic. The negative 2-mb anomaly in the Atlantic was due to the more nearly circular, rather than the normal elongated, configuration of the Bermuda-Azores High.

October averages two tropical storms, one of which reaches hurricane strength. This month will help decrease that average as none occurred. In the 31-yr period since 1941, this has occurred in only three other years--1959, 1966, and 1970.

The significant storms in the North Atlantic during October were fairly evenly dispersed throughout the month. All were in the northern and western area except one that tracked eastward across the central Atlantic and one that developed off the Spanish coast. The first storm developed as a LOW, from a wave on a cold front, near 50°N, 66°W. The DAWSON reported 40-kt winds from the south and 15-ft seas just

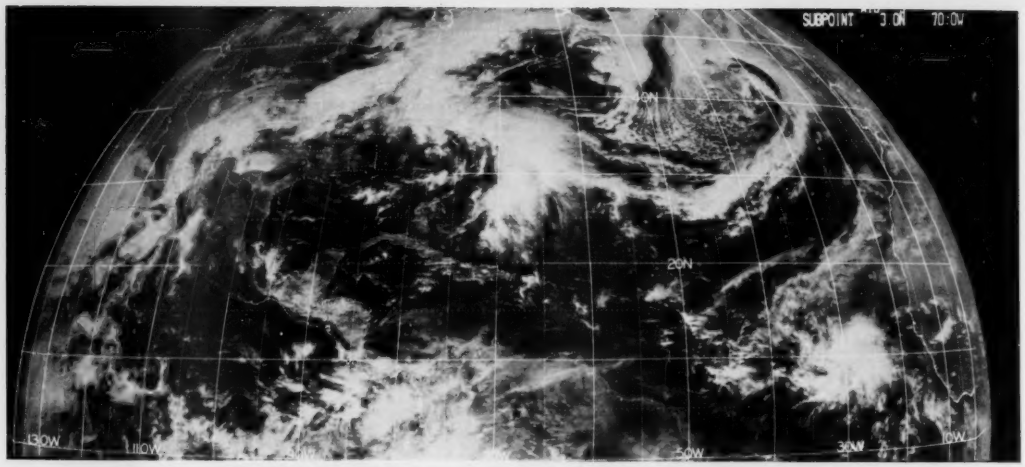

Figure 29.--The LOW's center is located near 45°N, 33°W, at 1546 on the 6th. The frontal system extends northeast out of the LOW, then curves south and then westward, across the Atlantic to another LOW off Cape Hatteras, which is also described in the text.

off the Labrador coast. Twelve hours later, at 1200 on the 1st, the DAWSON was still battling the high winds and seas, with Ocean Station Vessel "B," on station, being hounded by 40-kt winds as the front passed. As the LOW, now down to 975-mb, traveled up the Davis Strait, another LOW developed at the point of occlusion and took the high road along Greenland's East Coast. As the 988-mb storm passed to the west of Ocean Station Vessel "A" on the 2d, that vessel had howling 40-kt gales and seas of over 20 ft. It seemed this particular storm had a dislike for Ocean Station Vessels.

The storm continued to the northeast for the next 36 hr. Its location, at 1200 on the 3d, was 73°N, 6°W, with a central pressure of 974 mb. At that time, Ocean Station Vessel "M" also reported 40-kt winds. A coastal station at Alesund, Norway, and another on the northeast coast of Greenland, both reported 35-kt gales. The LOW continued to move eastward along 75°N, but it was no longer a threat to shipping.

While the above storm was raging, another LOW was quietly developing near 45°N, 15°W, on the 2d off the northwest corner of Spain. At 1200 on the 2d, the pressure had dropped to 999 mb. During the next 24 hr, the storm drifted southward and deepened. As the gradient tightened, the winds increased, and by 1200 on the 3d, the following ships were reporting 35- and 40-kt gales with seas to 15-ft. They were the BERGEN MARU, CINULIA, FORT FLEUR DEPEE, and TACTICIAN. At 0000 on the 4th, the center had reached its farthest position south and started a northward movement. The JACQUES CARTIER and the FNAW reported 35- and 40-kt winds, respectively, with accompanying 12-ft seas. Ocean Station Vessel "K" was pounded by winds up to 35 kt from all directions as the LOW passed directly over its position. The center continued its drift northward while filling, and was absorbed on the 7th by a system that trekked eastward from the western Atlantic, with a southerly component.

Going back to the first storm described, a series of waves, traveling northeastward, formed on the front. On the 3d, another wave formed just off Newfoundland with a small closed center of 1010 mb. On the 4th, this LOW was moving northeastward, slowly deepening. By 1200 on the 5th, the central pressure was down to 999 mb and the direction of travel had taken a definite southerly component. The QUEEN ELIZABETH 2 reported 35-kt northerly winds near 46°N, 44°W. Several ships were regaled with winds from 35 to 40 kt and seas up to 15 ft on the 6th when the storm center was located near 45°N, 34°W (fig. 29). They were the AMASTRA, CASTILO DE LAMATO, LANGSTONE, NORSE VIKING, SOLON TURMAN, EXPORT AIDE, and Ocean Station Vessel "C." On the 1200 report, Ocean Station Vessel "D" reported she was being rocked by winds of 50 kt and seas of 15 ft. All reports were from vessels to the west or south of the LOW. On the 7th, the winds were a consistent 40 kt in a jet band on the southwest side of the 992-mb LOW. The FUTAMI MARU, NORSE VIKING, and the ASHBANK were harassed as the LOW stopped for a rest. The 15- to 25-ft waves gave little respite to the ships' crews. On the 8th, it moved southeastward and filled to 1006 mb. The deterioration process continued until the 10th, when all identity was lost near the Canary Islands.

The frontal system associated with the two previously described LOWS was very prolific in the generation of significant storms. On the 5th, a portion of the front was stationary along 30°N, extending westward into Northern Florida. An inverted trough developed off the Florida to Carolina coast as the attendant HIGH passed over Nova Scotia. The EDE SOTTORF, at 37.5°N, 63.5°W reported a 35-kt gale. By the 6th, the trough had spawned two LOW centers, with the northerly one down to a pressure of 1003 mb, and located off Cape Hatteras (fig. 29). At 0000 on the 7th, the

CARBIDE TEXAS CITY and the EMERILLON reported 35- to 40-kt easterly winds. By 1200 that day, the ATLANTIC CROWN and the DART ATLANTIC had encountered a breezy 35 kt and the AMERICAN ALLIANCE and the RIEDERSTEIN were buffeted by 40-kt gales. The LOW was now speeding up the Atlantic coast with a 987-mb center.

This storm had a different personality than most others, in that the high winds were east of the LOW, ahead of the cold front, and along or north of the warm front. On the 8th, the LOW registered 976 mb and was located over Cape Cod. North of the warm front, the AMERICAN ALLIANCE was bucking 55-kt crosswinds, and the RIEDERSTEIN was heading directly into 50-kt southerlies. The CETRA COLUMBIA, USCGC INGHAM, DART ATLANTIC, FORT TRINITE, and the RIO MANAMO were not exactly enjoying the 35- to 40-kt tempest and 15- to 20-ft seas over a wide area.

The storm raced northward to combine with the major LOW cell in northern Quebec on the 9th, and the strong wind band moved northeastward with the front. The SEDNETH I, a drilling platform, and Ocean Station Vessel "B" were plagued by 40-kt gales. Twelve hours later, the drilling rig SEDCO and Ocean Station Vessel "B" were still being rocked by 35-kt breezes. On the 10th, only the USCGC SPENCER, cruising just south of Greenland, reported gales of 35 kt. The combined system moved north up the Davis Strait on the 11th and 12th, and this spelled its doom.

This LOW caused more than the usual damage and heartaches along the U.S. East Coast. New Jersey and Virginia received heavy rains with attending floods. The Appomattox River rose to its highest level in 32 yr. Winds gusting to 40 kt were common along the Virginia coast. Three small-craft were swamped, capsized, or sank in the Long Island to Cape Cod area with loss of life. All were near shore but were unable to cope with the 35-kt gales and 6- to 10-ft seas.

Monster of the Month--This storm originated on a frontal system that stretched from Norway, southwestward to Cuba. A small cyclonic circulation developed early on the 22d near 26°N, 64°W. At 0000 on the 23d, the area of low pressure had expanded with three small LOWS. By 1200 that day, the northernmost LOW center (37°N, 53°W) started moving northeastward as a wave on the front, leaving a large area of low pressure behind, located near 30°N, 61°W at 1540 (fig. 30). The LOW continued to travel northeastward along the front for the next 24 hr. At 1200 on the 24th, the LOW had consolidated and attained a central pressure of 1006 mb near 44°N, 43°W. Ocean Station Vessel "D" experienced a breezy 35 kt. Twenty-four hours later, the NORSE VIKING and the JOSEF STEWING were hit by 35-kt gales. At 0000 on the 26th, the LOW had sped to 53.5°N, 23.5°W with a pressure of 973 mb. She was really wrapping up. Ocean Station Vessels "C" and "J," and the KRASNOKAMSK relayed 35-kt gales. The ENISEILES was pounded by 50-kt winds and 25-ft seas near 49.1°N, 23.2°W, while the JOSEF STEWING was still bucking 40-kt headwinds, 500 mi to the west. For the next 24 hr, the central pressure changed very little as the LOW continued northeastward. The C. P. EXPLORER was battered by 45-kt winds as the center passed very near her position. The C. P. VOYAGEUR

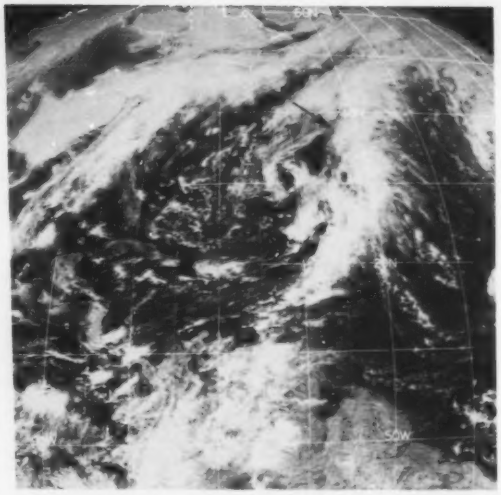

Figure 30.--This ATS-3 picture gives no indication, at this time, that the small wave shown by the arrow, will develop into the Monster of the Month. Note the "donut-shaped" cloud pattern associated with the low-pressure area, from which the wave developed.

and the CRANIA, both encoded 40-kt gales with high seas. Ocean Station Vessel "J" was disturbed by 35- to 40-kt winds during the LOW's passage. On the 27th, the LOW took its last swipe at the major shipping lanes, and it was the most powerful. The C. P. VOYAGEUR and the ATLANTIC CAUSEWAY were both rocked by winds of 55 kt. The RHEIN EXPRESS, near 47.5°N, 22.0°W, reported 40-kt winds and 18-ft seas. Ocean Station Vessel "J" was bounced about by 45-kt gales and 30-ft waves. About this time, the forward movement of the LOW slowed down, turned toward the north, then northeast, and filled gradually. By the 30th, the LOW was in the vicinity of Iceland, having been robbed of its strength and absorbed by a subsequent LOW that had developed in the same area as this storm.

Casualties--There were a variety of weather-related incidents this month. The 16,157-ton ALGORAIL damaged her hull when she was blown against a pier by a strong wind, while entering the Holland Harbor Channel from Lake Michigan. The icebreaker EDISTO and the research vessel MIZAR were trapped in a 2-m. thick icepack after colliding. The collision damaged the EDISTO's steering. The 2,317-ton U. S. nuclear submarine TULLIBEE and the 5,620-ton West German freighter HAGEN collided in heavy seas and stormy weather 150 mi east of Cape Hatteras. Luckily, no injuries were reported in any of the above mishaps.

ROUGH LOG, NOVEMBER 1972--The storm tracks were near normal both in number and location. The mean central pressures were, possibly, slightly lower, and the tracks more southerly across the eastern United States. This would result in more

easterly, rather than westerly winds across the Great Lakes. The U.S. Atlantic coast to the Norwegian Sea was definitely the favorite road. One LOW center tracked to the African Coast and one into central Europe.

The location of the storm tracks are reflected in the mean pressure centers and pressure anomalies. The Bermuda-Azores High (1022-mb) was well east of its mean position, and a ridge extended throughout the Mediterranean Sea, replacing a climatic 1014 mb Low. The Icelandic Low, which climatologically has two 1000-mb centers--one in the Davis Strait and one in the Denmark Strait, southwest of Iceland--was located approximately 700 mi east of Keflavik, with a mean pressure of 994 mb. A major trough extended west-southwestward from the Low, across Iceland to the southern tip of Greenland. A second major trough extended from the tip of Greenland, southward, and then southwestward off the U.S. East Coast. This easterly shift of the major pressure centers resulted in the westerly zonal flow being shifted from northern Atlantic waters to northern Europe. The anomalies were in direct relation to the shifts of the pressure centers. A negative 13-mb center was located in the Norwegian Sea, extending to a negative 14-mb center in Siberia. Another negative 6-mb anomaly was centered at 40°N, 50°W. A positive 4- to 7-mb anomaly extended from 30°W, eastward across southern Europe and northern Africa. A horseshoe-shaped positive 4-mb was located in east-central Canada.

November averages one tropical storm every 3 yr and of these, half will develop into hurricanes, or, one every 6 yr. There were none this year.

Monster of the Month--A 1009-mb LOW developed in Kansas on the 1st, and by the 4th, had moved eastward across the Great Lakes. At 0000 on the 4th, it was centered at 45°N, 60°W, with a central pressure of 992 mb. At that time, the E. E. PRINCE reported 40-kt gales and the LOPPERSUM had 35-kt winds to the south and southwest of the LOW. Twelve hours later, as the storm moved farther to sea (fig. 31) and over the Gulf Stream, the pressure dropped to 984 mb. The ATLANTIC CAUSEWAY was blasted by 55-kt winds near 54°N, 59°W. The DART AMERICA and the SHEAF TYNE were rocked by 45- and 40-kt gales, respectively. By 1200 on the 5th, the LOW had raced to 59°N, 35°W, with the pressure down to 959 mb. It was really wrapped up. Several ships were involved in the cyclonic circulation. The USCGC MORGENTHAU was hammered by hurricane-force 65-kt winds and 21-ft seas, 200 mi to the southeast. The DUKESGARTH fared only slightly better with blasts of 55 kt, 350 mi southwest of the center and the GLEN AVON suffered 45-kt gales as far as 550 mi southwest of the LOW. Other ships reported gale-force winds as far away as 600 mi in the southwest quadrant.

The LOW continued on a steady course to the northeast with the pressure dropping to a minimum of 952 mb, at 0000 on the 6th. At that time, it was located near 62°N, 34°W. The USCGC MORGENTHAU continued her northeasterly course paralleling the storm. At 0000 she was near 59.8°N, 30.0°W, still taking a 60-kt pounding while the seas had increased to 30 ft. The BORE 3 and the ERIKA DAN, both suffered through 50-kt winds and seas as high as 26 ft, all in the southeast quadrant of the storm.

During the next 24 hr, the LOW moved over Iceland and started to show its age. The pressure had risen

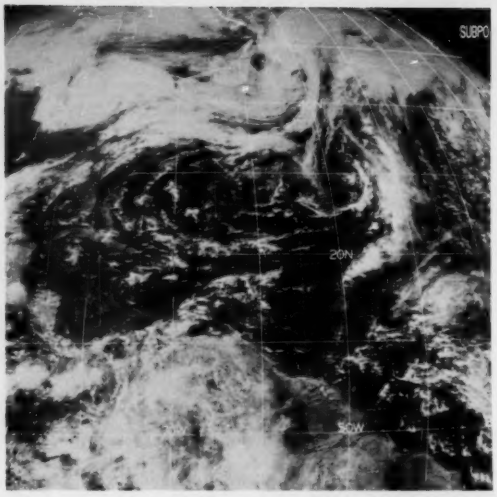

Figure 31.--The Monster of the Month, at 1547 on the 4th as it passed east of Newfoundland near 48°N, 49°W, with a central pressure of 980 mb. The LOW continued to track northeastward, and the pressure fell to 952 mb by the 6th.

to 971 mb and the gradient had slightly weakened by 0000 on the 7th. In the meantime, Ocean Station Vessel "I" was treated to a 55-kt hammering as the USCGC MORGENTHAU continued to follow the LOW, but the wind speed had decreased to 45 kt. The VICTORE, 400 mi south of the LOW center, was rocked by 50-kt gales, and the MAI, just south of Iceland, rolled with 45-kt gales. During the next 48 hr, the LOW moved to near 69°N, 10°E, or just off the coast of Norway. The filling process continued with a few reports of 35- to 40-kt gales in the Norwegian Sea. The storm was not yet finished, though, it spawned an offspring in the Denmark Strait on the 7th, and another south of Iceland on the 8th. They continued to grow, and on the 9th, united to form a system stronger than the aging parent. At 1200 that day, it was located near 62°N, 14°W. The PHOTINIA, which was 550 mi to the southwest, battled 50-kt headwinds. At 1600 that day, the British trawler, SSAFA 155, radioed an SOS from 130 mi off the Vestmann Islands. A giant wave had swept over the ship, damaging the bridge, rendering the rudder useless, and cutting the auxiliary motors and all lights. The vessel was also taking water. A Hercules rescue plane of the Icelandic Defense Force, located the trawler and circled overhead, while awaiting the Coast Guard vessel AEGIR.

As the storm drifted off the Norwegian coast, another small LOW was born south of Greenland. This LOW raced eastward across Ireland and England into the North Sea, at 0000 on the 13th. At that time, the central pressure had fallen to 970 mb. Again the old LOW survived, but was surpassed in strength by the interloper. This LOW was truly a killer. Hurricane wind speeds, up to 110 kt, were reported in mountainous areas of Europe. The death toll reached at least 73, according to late reports, and the East German

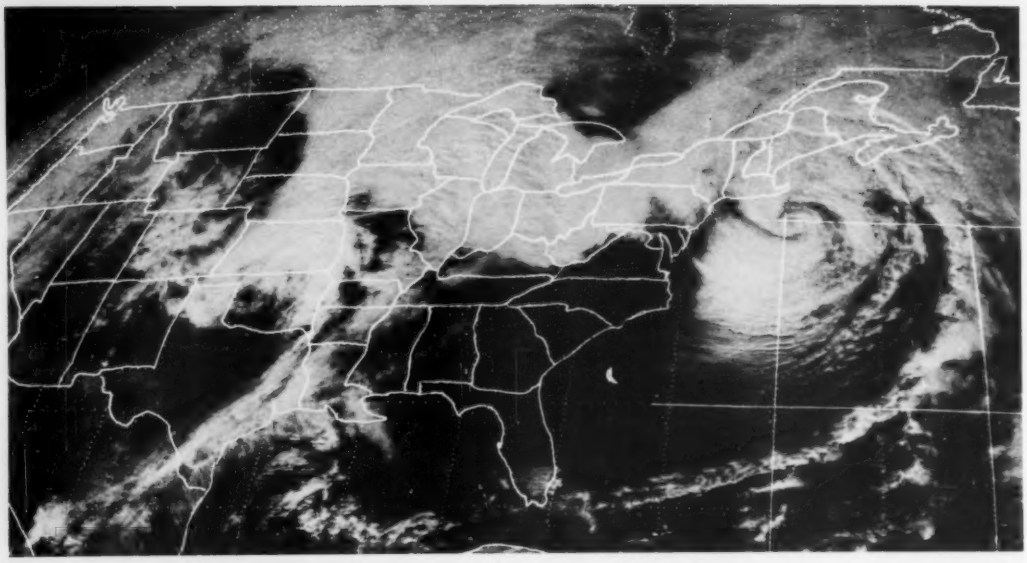

Figure 32.--The LOW is well defined by the associated cloud pattern, at 1800 on the 9th. The center is located near 40°N, 69°W, in this ATS-3 picture.

news agency said 118 persons lost their lives. The destruction from the winds and rains amounted to many millions of dollars. The first blimp built by West Germany since World War II was destroyed. The 22,391-ton Greek bulk carrier, MASTER PETROS, was grounded in the Ems River. The killer LOW circled the original LOW, which remained stationary near 64°N, 5°E, and finally completely conquered it on the 17th.

A diffuse frontal system, in the midwestern United States on the 4th and 5th, attained better organization on the 6th, and a 1008-mb LOW formed west of Lake Superior. Sixty hours later, the LOW was centered over Long Island with the central pressure down to 982 mb. Record rain lashed New York City with 4.6 in. in 12 hr. This broke all records for a November rainfall. Wind gusts up to 45 kt were recorded. The buoy EB-01 reported 40-kt gales as did the ESSO MIAMI and the NINA BOWATER, south of the LOW's center. At 1200 on the 9th (fig. 32), the ESSO MIAMI, on a northerly course, was converging with the LOW and receiving 50-kt gales. The LOW moved almost due eastward and the pressure was 987 mb at 0000 on the 11th, near 41°N, 55°W. The cyclonic circulation covered most of the western middle North Atlantic. Gale-force winds up to 40 kt were reported by many ships up to 600 mi from the center. Thirty-six hours later, at 1200 on the 12th, the JOHANN SCHULTE was headed directly into 60-kt northerlies near 48°N, 47°W. The ANDREA BROVIG, CITY OF OXFORD, and the JUNGE GARDE were regaled with winds of 40 to 45 kt, during that period. The JOHANN SCHULTE was still battling 55-kt headwinds 12 hr later.

In the next 24 hr, the storm completed a counterclockwise loop centered near 44°N, 47°W. During this period, the AMERICAN ALLIANCE and the STEFAN BATORY encountered 40-kt gales near 46°N, 40°W, north of the LOW. The LOW continued its counterclockwise motion and was located near 50°N, 47°W, at 1200 on the 15th. Ocean Station Vessel "B," the drillings rigs SEDCO and SEDNETH, the VASSILII SOURIKOV, and the VIKTOR LYAGIN, all were buffeted by 40-kt gales.

At 0000 on the 16th, the LOW sped off to the west to near Belle Isle, as another LOW moved to just south of Newfoundland from the southwest. Ocean Station Vessel "B" reported 50- and 55-kt easterly winds at this time and 12 hr later. As the original LOW stalled near Cartwright, Labrador, and the second LOW continued its north-northeasterly track, Ocean Station Vessel "B" was pounded by 60-kt winds and the VASSIA CHICHKOVSKII, very close to the LOW's center near 54.5°N, 47.5°W, encountered 40-kt gales. On the next chart, the system of two LOW's started moving eastward, converging again into one LOW over Scotland on the 20th. In the meantime, many ships and coastal stations suffered 35- to 50-kt gales. These included Ocean Station Vessels "C," "D," "J," and "K." The LOW continued moving eastward into the Baltic Sea and then into northern Russia, where it was defeated by the cold land mass.

A 999-mb LOW was located on the Oklahoma-Kansas border on the 13th and moving eastward. On the 14th, the LOW center tracked up the Ohio River valley (fig. 33) producing northeasterly winds over the Great Lakes. Winds of 20 to 30 kt with gusts of 30 to 40 kt were recorded over northern Ohio and eastern Michigan. Port Clinton, Ohio, had winds clocked at 65 kt with gusts to 95 kt. Over Lake Erie, northeast winds of 50 to 60 kt caused the water level to rise about 9.5 ft above normal in the Toledo area. Waves of 5 to 10 ft occurred along the Michigan shore of the Lake. It was estimated that 8,000 people had to be evacuated from their homes along a 32-mi stretch of Lake Erie in

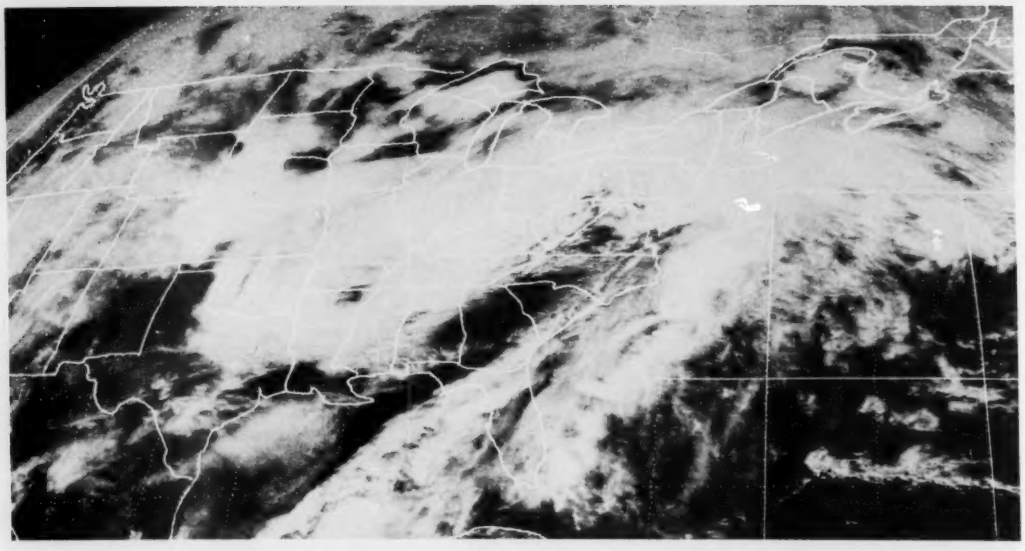

Figure 33.--This ATS-3 picture taken at 1400 on the 14th, shows the extensive cloud pattern associated with this storm as it moved across the eastern United States and out to sea near the Delmarva Peninsula.

Monroe County, Mich. Flood waters were up to 5 ft deep in parts of the area. Many others were evacuated along the western shore of Lake Huron and Lake Michigan. Monroe County Officials, including Port Clinton, estimated that damage would amount to at least $1 million. There were no reported deaths due to the storm in Michigan or Ohio, but the storm was, at least partially, responsible for 19 deaths in its sweep across the United States to the Atlantic. It triggered tornadoes in Texas, heavy rains in the northeast, and up to 18 in. of snow in Vermont and Maine. Flashfloods occurred in many areas.

As the storm passed off the U.S. East Coast on the 15th, it produced heavy rains along the coast and snow in northern New England. A houseboat was overturned off Elizabeth City, N.C. The Coast Guard rescued the couple that were on board. The SEA MAID and the SHOZEN MARU reported 35-kt gales ahead of the cold front accompanying the LOW. The LOW, now down to 983 mb, followed a northeasterly course, and, at 1200 on the 16th, was near 49°N, 51°W. The EDE SOTTORF, ESSO GHENT, and the USCGC BOUTWELL were all treated to 35-kt gales during this time. On the 16th, this LOW combined with the previously described storm and both moved easterly as one storm, on the 17th.

On the 0000 chart for the 17th, a 1008-mb LOW was analyzed off Savannah, Ga. Twelve hours later, the pressure had dropped to 997 mb and a ship reported 40-kt gales just to the north of the storm. By 1200 on the 18th, the LOW was located near 39°N, 66°W, with a pressure of 985 mb. Ocean Station Vessel "H" was battered by 50-kt winds, and a nearby ship reported 23-ft seas. The OCEANIC, just off Wallops Island, Va., on an easterly course, had to contend with 40-kt northerly winds. The storm reached the Grand Banks, off Newfoundland, on the 19th. The AMERICAN LEGACY, MIJDRECHT, and USCGC TANEY were pounded by 45- and 50-kt gales with seas up to [illegible] in the southwest quadrant, as the storm passed their positions. The drilling rig SEDNETH was hammered by 60-kt northerlies and waves of 21 ft.

The next 48 hr found the LOW moving eastward and then southeastward with a slight filling. The pressure was 989 mb at 1200 on the 21st. The gradient had weakened, and 40-kt winds were the strongest reported by the AMERICAN LEGACY, USCGC DALLAS, and the VELAY. The ITTERSUM also encoded 40-kt winds and was rocked by 33-ft swells, south of the LOW center. On the 22d, the storm passed over the Azores and the NORDENHAM was hounded by 45-kt gales. The LOW was now filling rapidly, and its last vestige was noted near the Canary Islands, on the 26th.

This innocent little storm was born near 42°N, 49°W, in the trough of a low-pressure area that was moving through the Denmark Strait on the 25th. The central pressure of the LOW, at that time, was 1002 mb. A few minimal gale-force winds were already being reported. On the 26th, the storm was deepening and racing north-northeastward. Both Ocean Station Vessels "C" and "D" reported 40-kt gales as it passed west of their positions. At 1200 on the 27th, the central pressure had dropped to 966 mb and the LOW was located just south of Iceland. The CARREL and the USCGC BOUTWELL, which were near 53°N, 30°W and 55°N, 30°W, respectively, were hammered by 50-kt gales. The ATLANTIC STAR, C.P. AMBASSADOR, MANCHESTER CONCEPT, RITVA DAN, and Ocean Station Vessels "C" and "I," all south of the storm, were buffeted by 40- or 45-kt winds. The

CARREL and Ocean Station Vessel "C" reported waves up to 25 ft. On the 28th, as the LOW passed over the Faeroe Islands, Ocean Station Vessel "J" suffered from 50-kt winds and 25-ft swells. The tight gradient and strong winds passed into the North Sea. Danish helicopters had to rescue 53 men from the drifting British oil rig, OCEAN TIDE, which was being towed. The LOW continued its eastward movement but filled as it passed into the Gulf of Bothnia.

Casualties--The 15,854-ton AMERICAN LEGACY collided with the drilling platform PENTA, in dense fog at Havre on the 2d. She lost the starboard anchor and chain; they were eventually recovered. The 16,987-ton Liberian carrier THEOMANA reported damage to deck and machinery due to heavy weather. A heavy gale split the 7,600-ton Canadian-registered MICHIPICOTEN, near Anticosti Island, Gulf of St. Lawrence, on the 17th. She was in tow of the tug KORAL, when she broke in two. The bow sank on the 17th, and the stern on the 18th. The Cyprian steamer, SANTA EIRINI, 2,006-tons, reported into Brest on the 23d, with a list reportedly due to heavy weather.

Rough Log, North Pacific Weather

October and November 1972

ROUGH LOG, OCTOBER 1972--Cyclone activity over the North Pacific during October was near normal, both in number and area traversed. Except for isolated circumstances, all major extratropical cyclone tracks were north of 35°N. The primary tracks were out of Siberia, across the Sea of Okhotsk, and into the Bering Strait; and from east of Japan, up the Aleutian Island chain, and into the Gulf of Alaska. A secondary track was from northeast of Midway Island, north-northeastward into the Gulf of Alaska.

The Aleutian Low, normally centered over the Alaska Peninsula, northwest of Kodiak Island, was near 60°N, 170°W, in the Bering Sea. The mean central pressure of 1005 mb was 5 mb higher than normal. The eastern center of the Pacific High was 2 mb higher than the normal mean of 1022 mb and 11° to the north (40°N, 140°W) of the mean position. The western Pacific center of the elongated climatological High was located near its usual mean position of 30°N, 175°E but was 3 mb higher than its normal 1019-mb value. The trough separating the two was deeper and sharper. This, at least partially, explains the lack of cyclonic activity south of 25°N. The largest anomaly was a positive 9-mb, north of the position of the eastern Pacific High, just south of the Gulf of Alaska. A plus 3-mb anomaly was centered near 26°N, 120°W, off Baja California and a plus 3-mb anomaly ridge along 170°E from 30°N to 60°N. The sharp trough was reflected by a negative 2-mb anomaly near 35°N, 160°W.

Five named tropical storms occurred in western Pacific waters during the month. Four (Lorna, Marie, Nancy, and Olga) reached typhoon intensity; Kathy qualified for tropical storm status. In the eastern Pacific, only tropical storm Kathleen disturbed the peaceful waters.

The first storm of significance was conceived during late September but did not start to mature until October. On September 28, a 1004-mb LOW formed in a trough which was associated with a weakening stationary front. The LOW, and the front, moved steadily eastward, and at 0000 on the 1st the LOW was located at 45°N, 163°W, with a central pressure of 993 mb. During that day, the OKADA MARU and the WASHINGTON were regaled with 40-kt winds. The WORLD CREST, at 39°N, 171°W, was heading into 45-kt gales and 20-ft swells. By 0000 on the 2d, the LOW had raced to 54°N, 147°W, a distance of about 900 mi for a speed of 35 kt. The central pressure had dropped to 961 mb. The extremely tight gradient produced 40- to 50-kt winds which pounded the JAPAN, JAPAN-WALNUT, KUNGER, NIIHAMA MARU, PHILIPPINE MAIL, SUMMIT, and the WASHINGTON. A ship which could not be identified was hammered by 60-kt winds. The swells were generally 15 to 20 ft, but the SUMMIT encountered swells of 30 ft. On the 3d, the LOW passed into Alaska near Valdez and began to fill and weaken. At 0000 on the 3d, the AMSTELLAAN and the ZENIKOREN MARU reported 45- and 40-kt gales, respectively. Once over land, the LOW filled as rapidly as it deepened. The last identifiable remains was a 1014-mb trough at 0000 on the 4th, still near Valdez.

A LOW formed over the northern Kamchatka Peninsula on the 10th, and moved southeastward. Between the 10th and 13th, the LOW traveled to near 52°N, 173°W and the following vessels reported 35- and 40-kt gales: the HOYO MARU, JAPAN MAPLE, MARUSUMI MARU, and the ZENKOREN MARU.

On the 13th, a 1002-mb LOW developed on the front, south of the original LOW, near 40°N, 168°W. Twenty-four hours later, its pressure was 990 mb and was causing havoc over a wide area. The IDAHO, PRESIDENT LAUREL, and the PRESIDENT MCKINLEY were south and east of the LOW and bucking 35-kt winds. The DERWENTFIELD was regaled by 40-kt and the KLAUS LEONHARDT was hammered by 45-kt winds near the front.

The LOW moved north and deepened to 966 mb and was at 50°N, 166°W on the 15th. The KASHU, MARNE LLOYD, TACOMA CITY, TOYOTA MARU, and the TRANSOCEAN TRANS were hit by 35- to 40-kt winds to the south and west of the center. At the same time, the GAIST, JAPAN WALNUT, KURE MARU, and the WASHINGTON MAIL were being blown by southerly 35- to 40-kt gales along the front.

Late on the 16th, the LOW crossed northward into Bristol Bay and the colder waters started to take their toll. In the meantime, the ACILA, MITO MARU, NELSON MARU, and the WASHINGTON MAIL were hounded by winds up to 40 kt. On the 17th, the LOW approached the Bering Strait with the AMERICAN

MAIL reporting 40-kt winds and 26-ft swells near 57°N, 177°W. With the 4°C temperature, the chill factor made me glad to be in a warm office. On the 19th, all traces of the LOW had vanished.

On the 1200 chart of the 20th, a new LOW was analyzed with the help of many fine ship reports. This appeared to be almost an explosive development, as ship reports in the same and surrounding area 12 hr earlier indicated only a slight troughing upstream. The LOW center of 1004 mb was located near 43°N, 163°E where, 12 hr earlier, a straight flow (1016 mb) isobar appeared. The NIPPON MARU, 200 mi south of the center, was caught by 40-kt gales. The WOKO MARU was encountering 35-kt winds approximately 400 mi southwest of the LOW. Twelve hours later, at 0000 on the 21st, the NIPPON MARU was still being buffeted by 35-kt gales and the ACILA had joined her ranks. By 0000 on the 22d, the LOW had moved westward to 43°N, 175°W, with a central pressure of 990 mb. The winds had picked up considerably, with the BUENOS AIRES MARU being pounded by 50-kt gales and 15-ft swells; the TOYOTA MARU, at 36°N, 172°W, had heavy drizzle driven by 45-kt gales. The AKAGISAN MARU and the SILVER ARROW reported 35- and 40-kt winds. The former was exactly on the frontal position with heavy rain and a southerly wind. Twelve hours later, the ILLINOIS was pounded by 50-kt gales, as the LOW curved northeastward. On the 23d, the system developed dual LOWS, which weakened the gradient and lessened the winds. Only Ocean Station Vessel "P" reported 35-kt winds at this time. The LOW was located in the Gulf of Alaska on the 24th and had filled to 994 mb. The OTRADNOE was buffeted by 45-kt gales, south of Chirikof Island. A small HIGH over central Alaska and St. Elias Mountains, along the coast, absorbed the LOW, leaving only a trough on the 25th.

On the 26th, a 1004-mb LOW was slowly moving eastward out of Manchuria, where it was depositing moderate snow. It caused little concern to larger ships until the 28th, when its central pressure was 972 mb, and was located at 52.5°N, 152.0°E. South of the center, the HONSHU MARU had 35-kt gales while the MEISHUN MARU, OREGON MAIL, and the PACIFIC LOGGER were honored with 40-kt. As the LOW passed over the Kamchatka Peninsula, the HOLLANDS BRINK and the SETYU MARU were lashed by 40- to 45-kt westerlies. The LOW continued on an easterly track and on the 29th was at 56°N, 180°. The EASTERN BUILDER and the SAN FRANCISCO experienced 40- and 45-kt gales. About this time, things started falling apart as the LOW that once was typhoon Olga, approached from the southwest. The LOW continued on a northeasterly course, gradually weakening, and by the 5th, it was just offshore from Ketchikan, Alaska, and scheduled to be absorbed by another low-pressure system, fast approaching from the west.

Tropical storm Kathy and typhoon Lorna formed on the 1st day of the month. Kathy developed east of the Mariana Islands. Lorna developed in the South China Sea. Before the day was through, Lorna was a typhoon, with 70-kt maximum winds, bound for Hainan and Vietnam. Kathy's maximum winds were 60 kt. Both were on a west-northwesterly course. On the 2d, Lorna brushed southern Hainan, moved across the

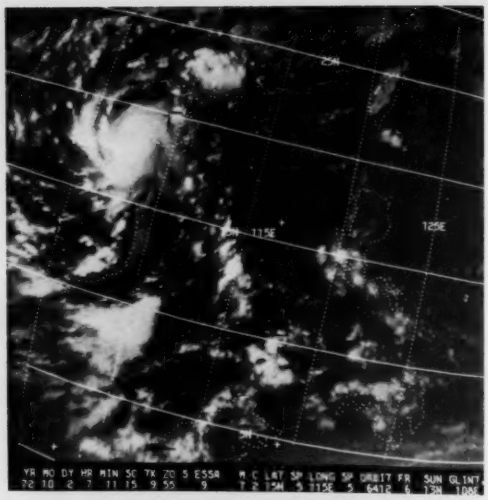

Figure 34.--Lorna prepares for an invasion of North Vietnam.

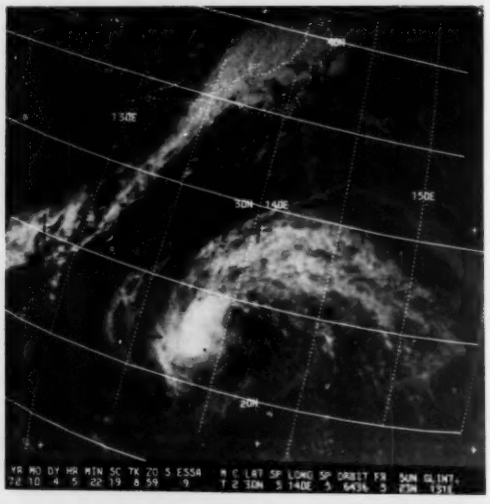

Figure 35.--Tropical storm Kathy, on the 4th, as she moved northwestward. The front that Kathy incorporated into her circulation on the 5th, extends southwestward from Japan.

southern Gulf of Tonkin and into North Vietnam (fig. 34). Winds remained at minimal typhoon force until Lorna was ashore. Meanwhile, Kathy jogged across the 20th parallel and headed westward. On the 3d, as Lorna was dying over land, Kathy maintained her 55- to 60-kt winds and plodded westward. The following day (fig. 35), Kathy recurved, first toward the northwest and then, on the 5th, toward the north.

Tropical storm Kathy on a northerly course had incorporated a cold front into her circulation and be-

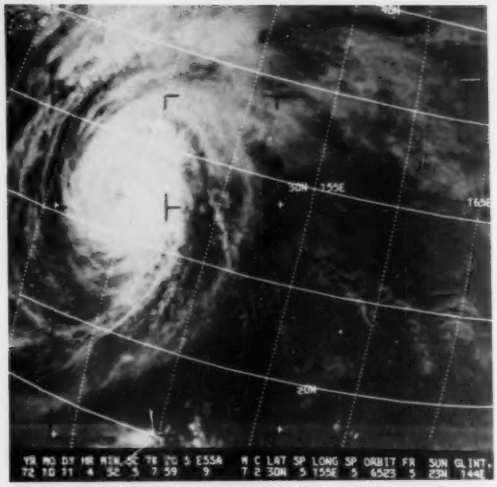

Figure 36.--Marie, in the October of her life, still has a fantastic circulation.

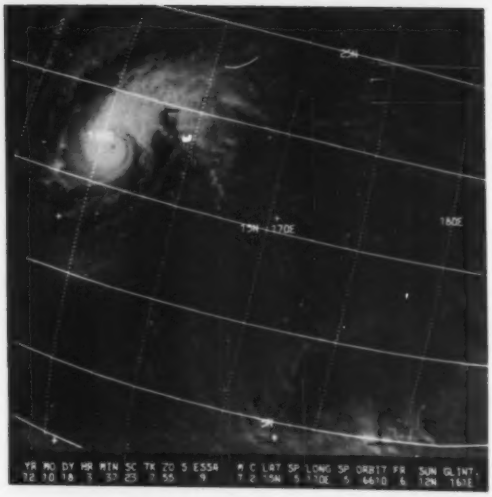

Figure 37.--Typhoon Nancy, near her peak, is a tight, potent storm.

came extratropical near 30°N, 137°E at 0000 on the 6th. The central pressure had risen to 1007 mb, but this was only a breather as the storm immediately started deepening with the cold air infusion and was reported down to 990 mb by 1200 that day. The JAPAN AZALEA became painfully aware of this as she encountered 45-kt gales, north of the LOW center near 38°N, 144°E at 1200. Many miles to the north, the KASHIMA MARU reported 40-kt winds along the same front, which was crowded into a tight gradient, on the back side of a large HIGH. On the 7th, the KLAUS LEONHARDT and the SAGAMI MARU were struck by 35- and 40-kt winds on opposite sides of the northeastward moving LOW. At 1200 on the 8th, the LOW was located at 44°N, 172°E and the GEORGIANA, KINKO MARU, and the VYSSOTSK were regaled by 35-kt winds and the DAIAN MARU, by 40-kt winds. The LOW was rapidly being crushed between the two high-pressure areas, and the gradient along the front remained tight due to this squeezing. The GEORGIANA (moving west toward the front and the northeasterly moving LOW), reported 40- and 45-kt gales with swells to 25 ft on the 9th. By 0000 on the 10th, the squeeze play had succeeded and the LOW no longer existed.

On the 5th, a tropical depression was sighted about 300 mi south of Wake Island. This was the start of something big--typhoon Marie. The depression became a tropical storm, and the tropical storm became a typhoon on the 6th. The typhoon moved west-northwestward at about 20 kt. Maximum winds, close to her core, climbed slowly--95 kt on the 7th; 100 kt on the 8th; 115 kt on the 9th. By the 9th, the storm had reached her peak. Marie, as dawn was breaking, moved into the northern Marianas. Winds of 100 kt or more extended 50 mi in all directions while gale-force winds extended out to 375 mi. Gusts near the center were estimated at 155 kt. On the 10th, Marie began to recurve and her winds began to drop. By the 11th, she crossed the 25th parallel near 144°E (fig. 36). Maximum winds were 90 kt near her center. Marie's center stayed more than 300 mi east of the Honshu coast as she traveled northward on the 12th. Her effect, however, was felt in Japanese coastal waters. The 77-ton fishing vessel, No. 81 YAHATA MARU capsized in these storm-whipped waters. While all the 18 crew members escaped in a rubber raft, all but two were lost prior to rescue. Marie turned extratropical on the 12th, as she crossed the 35th parallel near 148°E.

Nancy, the strongest typhoon of the month, was confined to a life at sea. She was detected in a tropical storm state about 250 mi southeast of Wake Island on the 16th. The following day, Nancy reached typhoon strength as she traveled on a westerly course. Nancy peaked on the 18th while recurving (fig. 37). Maximum winds reached 120 kt with gusts to 160 kt near 18°N, 160°E. During the next few days, the typhoon continued on a parabolic track that took her between Marcus and Wake Islands. Her intensity declined with increasing latitude. On the 19th, she crossed the 20th parallel at 120 kt, and the next day crossed the 25th parallel near 160°E, at 80 kt. Nancy began to turn extratropical, late on the 21st.

Olga developed deep in the Tropics. She was estimated to be at typhoon strength, east of the Marshall Islands on the 22d. The typhoon moved west-northwestward through the Marshalls on the 23d and 24th (fig. 38). The storm passed 150 mi to the northwest of Kwajalein, where a maximum sustained wind of 23 kt, from the north-northwest, was recorded on the 23d. Also observed, was a peak gust from the north at 33 kt. When Olga left the Marshalls, her maximum winds had dropped to 50 kt. Moving west-northwestward at about 15 kt, Olga reorganized on the 25th. By the 26th, she was again a typhoon near 14°N, 157°E. She continued to strengthen. The following day, Olga was a classic typhoon (fig. 39). Maximum winds reached 115 kt with gusts estimated to 150 kt. It was at this

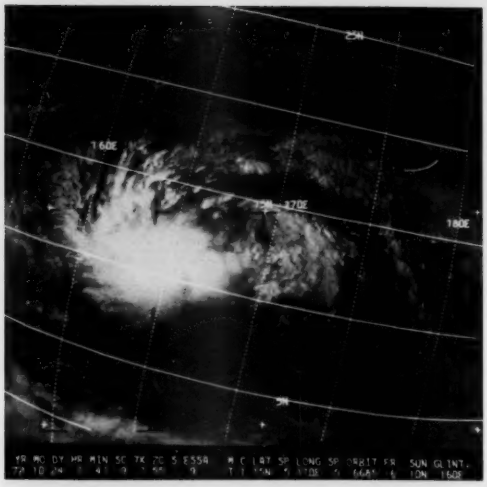

Figure 38.--Olga frolics among the Marshall Islands.

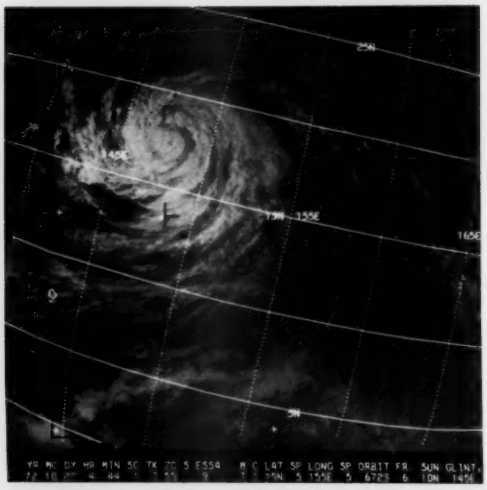

Figure 39.--Olga, at maturity, is ready to batter the northern Mariana Islands.

intensity that she banged through the northern Mariana Islands. Typhoon Olga began to recurve as she crossed the 20th parallel near 144°E. Winds began to diminish somewhat, and cold air began to turn Olga extratropical. Her movement was toward the north at a forward speed of 25 kt.

At 1200 on the 29th, typhoon Olga was declared extratropical at 34°N, 147°E with a central pressure of 980 mb. Most shipping had given Olga a wide berth, but on the 30th the RICHMOND MARU and the TAIKAI MARU were bounced by 40- and 45-kt winds with seas and swells up to 25 ft. At 1200 on the 30th, the central pressure was down to 966 mb near 46°N, 163°E and the TOYOTA MARU #8 was being pounded by 45-

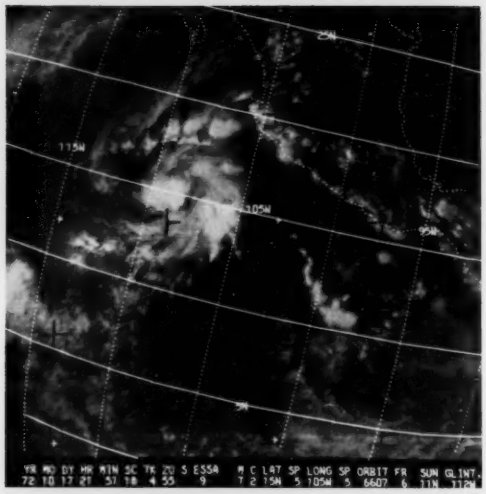

Figure 40.--Although Kathleen has al large area of cyclonic support, she did not develop to her full potential.

kt winds from all directions, as she passed very near the center of the LOW. Farther south by 500 mi, the MONTREAL MARU had an easier go with 40-kt gales, but the waves were running 25-ft. At 0000 on the 31st, the central pressure had fallen to 960 mb and the GZRY, and the TETSUZUI MARU were caught in 45- to 50-kt winds. The DAISHOWA MARU, which was closer to the LOW's center, was pounded by 60-kt winds, blowing in the same direction as she was headed.

By this time, it appears the word had gotten around and most ships were avoiding the storm, when possible. On November 1, the LOW was moving eastward along 45°N, and weakening. The HAI KING and the KOWA MARU were both buffeted by 40-kt gales, south of the center. The LOW continued its easterly course and, at 1200 on the 2d, was near 48°N, 144°W. During this time, the EVER LIGHT encountered 35-kt gales, and the AMERICAN ROBIN and the HARIMA MARU, which were closer to the center, were treated to 40-kt gales.

Tropical storm Kathleen developed in an active convergence zone 300 mi southwest of Manzanillo, Mexico, on the 17th (fig. 40). She was identified and tracked primarily by satellite pictures from ESSA 8 and 9. At 0000 on the 18th, Kathleen was located at 15.2°N, 109.5°W, moving west-northwestward at 10-kt with an estimated maximum wind speed of 40 kt. By 1200 that day, she was downgraded to a tropical depression and started to move northward, then northeastward On the 19th, she approached the Mexican coast with only showers and light winds.

Casualties--There were three weather-related mishaps that came to our attention this month, one of which was described under typhoon Marie. All were smaller type ships. The 104-ft MORNING STAR was sliced in half by an unknown merchant ship in heavy fog and high seas off Cape Mendocino, Calif., on the

5th; two lives were lost. The 492-ton SANYO MARU sank in Tsugaru Channel on the 17th. Winds were reported to be 30 kt. The skipper was the only one of seven crew members to be rescued.

ROUGH LOG, NOVEMBER 1972--The primary tracks were out of Manchuria and the Yellow Sea, across northern Japan, and into the Bering Sea or paralleling the Aleutian Islands and then into the Gulf of Alaska. Another favorite track was out of the central North Pacific into the Gulf of Alaska. A few of these then turned southeastward along the U.S. West Coast.

The 994-mb Aleutian Low was near its mean position but 6-mb deeper than normal. The Pacific High (1023 mb) was almost a duplicate of it s climatological counterpart (1021 mb). The elongated oval High stretched across the Pacific, centered on 30°N, from the U.S. West Coast to 160°E. The larger pressure anomalies were due to the lower pressure of the Aleutian Low and higher pressure of the Pacific High. A negative 6-mb anomaly was centered near 54°N, 175°W, in the southern Bering Sea. A second negative anomaly of 7 mb was near 49°N, 135°W, south of the Gulf of Alaska. Positive 2- to 3-mb anomalies occurred from shore to shore, roughly between 20°N and 35°N. A positive 12-mb anomaly was located in eastern Siberia, reflecting an intensification of a ridge of the Siberian High. This is significant, as only one LOW originated out of that area, north of 50°N.

There were three tropical storms in the North Pacific; Liza in the eastern, and Pamela and Ruby in the western. Liza reached tropical storm strength; Pamela, typhoon strength; and Ruby, supertyphoon strength. In the eastern North Pacific, one tropical storm can be expected each 3 yr with a rare one reaching hurricane intensity. Historically, there are five tropical storms every 2 yr in the western North Pacific, with two reaching typhoon strength.

The first significant storm of the month, as far as winds were concerned, developed as a 1007-mb LOW on the 5th near 43.5°N, 154.0°E. At 0000, two reports of 35-kt winds in the southwest quadrant were received. At 1200, the GEORGIANA, near 40°N, 155°E, was buffeted by 45-kt winds. The LOW continued its northeasterly track with the center passing up the Aleutian Island chain. At 1200 on the 7th, the 978-mb LOW was near 55.5°N, 158.5°W. The VANTAGE HORIZON, 550 mi to the south, was pounded by 60-kt winds with 25-ft seas and 30-ft swells. Twelve hours earlier, the HONSHU MARU and PIRAN were rocked by 40- and 45-kt winds. The storm turned eastward in the next 24 hr, and then southeastward as it passed through the Gulf of Alaska. On the 8th, the ROMANIC, heading northeastward, was rocked by 55-kt northwesterly winds, accompanied by 50-ft seas. In addition, the report indicated 40-ft swells. The 9th saw the LOW slightly weakening. Cape St. James reported 50-kt gales ahead of the front, and the MANDARIN VENTURE and OREGON MAIL had 45- and 50-kt winds, 400 to 500 mi behind the LOW. As the storm paralleled the coast, moving southeastward and then inland north of San Francisco on the 11th, it filled rapidly and no longer was a danger to shipping.

Returning again to the 5th, this time at 1200, a 1016-mb LOW was discovered in the Yellow Sea. Twenty-four hours later, this racehorse was near Hakodate, Japan. The pressure had dropped to 994 mb as it sped northeastward at over 40 kt. By 1200 on the 7th, it had slowed its forward pace, but the pressure was now 964 mb. Two stations in the Kuril Islands were hit by 50-kt winds. The SHUNTO MARU bounced with 55-kt winds and 35-ft waves, while the KENYU MARU, farther south, had to contend with winds of only 45 kt. The storm was near 51.5°N, 162.0°E, at 0000 on the 8th, with a central pressure of 960 mb--its lowest--and wound like a spring. It let off some of its energy by battering the WAKATOSAN MARU with 50-kt winds, 30-ft seas, and 50-ft swells. This occurred 450 mi south of the LOW. During the next day, the KAKUKO MARU and SOHIO RESOLUTE were both treated to gales of 50 kt, but the seas in the area to the south had dropped to 15 ft and the swells to 30 ft. As the storm entered the Bering Sea, the icy waters aged it rapidly and by the 12th it no longer existed.

At 1200 on the 14th, a new system was assembling in the Yellow Sea storm factory. The 992-mb LOW did not become significant until it had moved east-northeastward over Japan and was near 43.5°N, 155°E, at 0000 on the 16th. At that time, the SHOMEI MARU and the SHORYU MARU encountered 40-kt winds, about 180 mi to the southwest. The DOVER MARU, which was ahead of the cold front about 600 mi to the south, basked in 22°C southerly winds of 40 kt. At 0000 on the 17th, the LOW was registering 964 mb and moving to the northeast. These ships reported the following winds: BANARIO, 55 kt; CHUETSOSAN MARU, 50 kt; and the JAPAN ERICA, 45 kt; all in the southwest quadrant.

On the 18th, the LOW absorbed remnants of extratropical Pamela which had moved into the Bering Sea. Between the 18th and the 20th, the storm executed a counterclockwise loop in the vicinity of Fox Island. The DAISHOWA MARU, HARIMA MARU, JAPAN AZALEA, KASHIMA MARU, KASUGAI MARU, and the VYSSOTSK reported 40- to 45-kt winds during that time. The ANADARA, at 45°N, 175°E, encountered 50-kt gales accompanied by 25-ft seas, and swells of the same height. On the 20th, far to the north of the LOW near 61.5°N, 179.6°W, the Japanese fish factory ship, SOYO MARU, battled 50-kt winds with heavy snow. Close by, Cape Navarin was frozen by by -12°C north winds of 70 kt.

The LOW continued its northeasterly movement up the Aleutian Islands on the 21st, slowly filling. On the 23d, it moved into Alaska and by the 24th had circled over the Bering Strait and dissipated into only a trough.

A 1008-mb LOW developed near 30°N, 142°E, on a cold front extending out of the last described low-pressure area. It moved east-northeastward and then northeastward, slowly developing until, on the 24th, it was near 47.3°N, 158.0°W, with a central pressure of 960 mb. At that time, it started to show its true character. The HONSHU MARU was hit by 45-kt winds, 250 mi west of the LOW. The JAPAN CARNATION and the KINKO MARU, to the south and the southwest were treated to 50-kt gales. At 1200, on the 24th, the buoy EB-03 reported 40-kt east winds as did Ocean Station Vessal "P." On the 25th, the MOBILE and the JOSEPH D. POTTS were pounded by 50-kt winds as the storm proceeded northeastward into the Gulf of Alaska. On the 26th, as a last dying

effort, it kicked the MOBILE with 75-kt hurricane-force winds, near 55.5°N, 141.2°W, prior to entering Yukon.

An old, weak, low-pressure system drifted out of China and, on the 24th, started to regenerate over the warmer waters off Japan. The pressure at 1200 was 995 mb. By the 26th, it had moved to 47.5°N, 179.5°E, and the pressure was 980 mb. The MATSUSHIMA MARU encountered 45-kt gales near the tri-point of the frontal occlusion, many miles south of the LOW. On the 26th, the LOW passed over the Aleutian Islands into the Bering Sea and, contrary to the usual, continued deepening to a pressure of 956 mb while moving to 60.7°N, 173.5°W. The SOYO MARU, which had moved south to near 56.9°N, 172.8°W, was blasted with heavy snow driven by 55-kt winds. Twelve hours later, at 1200 on the 28th, the KASHIMA MARU, now heading southwestward, was pounded by 60-kt headwinds driving intermittent heavy snow. The air temperature was a bone-chilling -1°C. If that wasn't bad enough, the weather station at Mys Shmidta, on the Chukchi Sea Coast reported 80-kt winds with a -25°C temperature. Although the storm was rapidly dying on the 29th, several Siberian shore stations reported winds of 50 to 70 kt. By midday on the 30th, all evidence of any closed cyclonic circulation had disappeared.

In the western North Pacific, Pamela popped up on the 4th, about 300 mi east of the Philippines. The tropical storm moved due westward and intensified to typhoon strength as it moved across Samar on the 5th. Pamela retained her strength as she moved through the islands. Before the 5th was over, she was into the South China Sea. The following day, Pamela began to pick up strength as she churned west-northwestward (fig. 41). The typhoon reached peak intensity on the 7th, when maximum winds of 110 kt, with gusts to 150 kt, were found close to her center. At this time, she was turning northward. She reached the south coast of Hainan early on the 8th. Later that day, she moved northward into China and weakened but did not dissipate. The 8,343-ton Panamanian motorship VANMINT, in Hong Kong Harbor to be broken up for scrap, either broke adrift or dragged her anchor and went aground on the southern shore. Two watchmen on board were unhurt.

Pamela turned extratropical and recurved into the Yellow Sea on the 9th. Within 24 hr, she had raced across Japan, and at 0000 on the 11th, was near 43°N, 158°E with a pressure of 972 mb. Many ships knew the storm was in the area as 35- to 40-kt gales were reported as far as 900 mi to the south and southwest. The BLUE BIRD was battered by 50-kt freezing winds and heavy snow, 200 mi to the north. At 0000 on the 12th, the LOW was near 49°N, 173°E, with a central pressure of 936 mb. In a standard atmosphere, this is equivalent to a height of approximately 2,200 ft above sea level. The JAG ANAND battled 65-kt typhoon-force winds 180 mi to the southeast. The SETR wasn't enjoying a leisurely cruise, 300 mi to the east, with 55-kt winds and 40-ft waves. The JAPAN WALNUT, only 150 mi south, and the PHILIPPINE MAIL, 720 mi southwest, both had 50-kt gales.

The LOW continued to track northeastward and as it moved into the Bering Sea, ship reports were not as numerous. During the next 24 hr, the SUZUKAWA

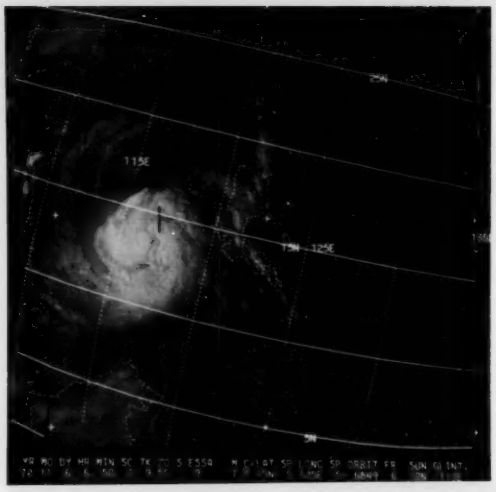

Figure 41.--Pamela punishes the Philippines and moves on.

MARU was battered by 55-kt winds, 33-ft seas, and 50-ft swells, 350 mi southeast of the LOW. The JCHF, JDND, and the 5CWD, all reported 50-kt winds south and southwest of the center. Many island and shore stations around the Bering Sea had winds over 35 kt.

By 0000 on the 14th, the 966-mb LOW had moved northward to 59°N, 179°W. The cold Bering Sea was slowly conquering the storm. It still had some fight left, though, as the SPERO bucked 40-kt westerly headwinds south of the Aleutian Island chain. North of the island chain, about 350 mi south of the LOW, the ZEKOREN MARU No. 2 was boosted along by 50-kt westerly winds, but the 15-ft seas and 33-ft swells were of no help whatsoever. Early on the 15th, the USCGC JARVIS ran aground at Dutch Harbor in high seas and winds. Emergency repairs were made, but later in the day her engineroom flooded. The Japanese ship, KOYO MARU No. 3, took the cutter in tow to Beaver Inlet at Sedanka Island.

Supertyphoon Ruby formed just east of the International Dateline. The hurricane became a typhoon on the 14th. It moved west-northwestward at about 12 kt. On the 16th she was located near 14.5°N, 171.5°E with a well-defined eye (fig. 42). Ruby intensified quickly and dissipated just as fast. Maximum winds reached 130 kt with gusts estimated at 170 kt on the 17th, near 16°N, 169°E. Thirty-six hours and 500 mi later, Ruby was a depression. By the 20th, she was unidentifiable.

Rare November eastern Pacific tropical cyclones usually form close to the coast, recurve quickly, and are often potent. Tropical storm Liza formed in the right vicinity (11°N, 97°W), on the 13th (fig. 43), but neither recurved nor became potent. She moved on a westerly track at 5 to 10 kt during her brief 3-day life. Liza reached tropical storm strength on the 14th near 10°N, 99°W. Maximum winds were estimated at 50 kt with gusts to 70 kt. Liza continued

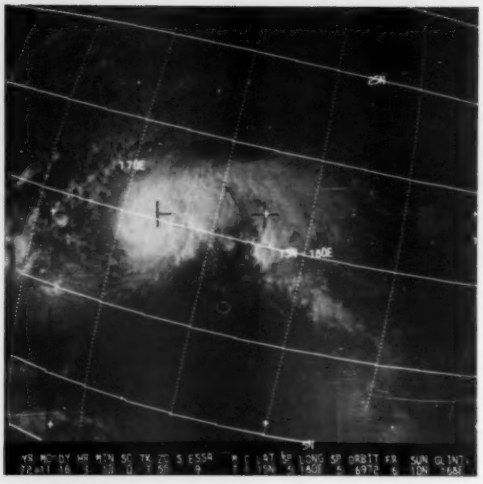

Figure. 42. --Typhoon Ruby, on the 16th, prior to becoming a supertyphoon on the 17th.

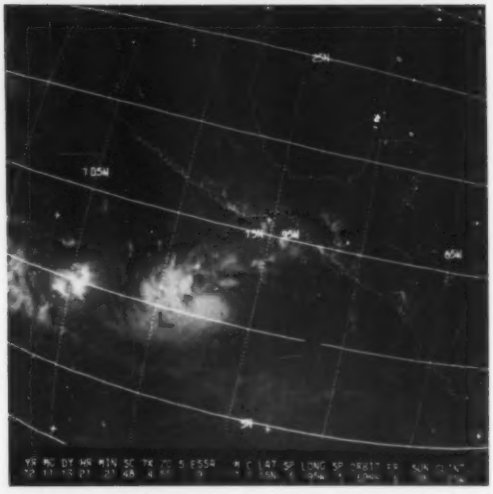

Figure 43. --Tropical storm Liza in her formative stage on the 13th.

westward during the 15th, but dissipated before crossing the 105th meridian.

Casualties--The Japanese yacht, MERMAID II, 2 days out of Tannowa Port on a round-the-world, nonstop solo voyage, lost all four masts in winds reported to be 54 kt about 60 mi south of Cape Shio on the 14th.

The 65-ton Japanese trawler No. 25 KONKO MARU sank in stormy waters with winds of 40 kt, on the 21st, off Cape Sata. Nine of eleven crew members are missing. The 9,803-ton Monrovian bulk carrier EASTERN BUILDER had her no. 1 winch damaged by deck cargo which broke loose during heavy weather.

Marine Weather Diary

NORTH ATLANTIC, JANUARY

WEATHER. January is generally characterized by rough weather over the middle and northern latitudes of the North Atlantic. LOWS frequently become deep, and associated winds often reach gale and sometimes hurricane force. The Icelandic Low (1000 mb), centered off the extreme southeastern tip of Greenland, is deeper than at any other time of the year. The Azores-Bermuda High with a central pressure of about 1023 mb covers a band from the western Mediterranean Sea west-southwestward to the waters northeast of the Bahamas.

WINDS. North of 40°N, the prevailing winds are westerly over most of the ocean. Over the Norwegian Sea and the North Sea, winds from the southerly quarter prevail. The average wind speeds are predominantly force 4 to 6, except up to 1,200 mi south and east of the southern tip of Greenland and over the Labrador Sea where they reach force 5 to 7. Between 25° and 40°N, the wind direction is from the southwest quarter of the compass over the main body of that portion of the Atlantic, mostly easterly over the Gulf of Mexico, variable over the waters east of Florida, and northerly or northeasterly from west of the Iberian Peninsula to the Canary Islands. Westerlies still dominate over the Mediterranean Sea. Force 3 to 4 winds are the most common except off the coast of the middle Atlantic United States where force 4 to 6 winds prevail. From the Equator to 25°N, the "northeast trades" persist; more than 65 percent of the time wind speeds range from force 3 to 5, except south of 10°N where these winds blow more than 50 percent of the time.

GALES (winds force 8 and higher) occur in 10 percent or more of the observations north of 35°N over the western part of the ocean and north of 40°N over the eastern part. The Mediterranean Sea hosts 10-percent frequencies out to 150 mi from the Gulf of Lions, over the northern Adriatic Sea, and over most of the Aegean Sea. The highest frequency over all North Atlantic waters, 30 percent, is found over a small area centered at about 58°N, 30°W, over a narrow belt off the southern tip of Greenland between 38° and 52°W, and (because of the mistral) over the Gulf of Lions.

EXTRATROPICAL CYCLONES. During the winter months (December, January, and February) LOWS form most frequently in a band 150 to 250 mi wide stretching from the North Carolina-South Carolina border northeastward to about the latitude of Cape Cod. This is part of a large area of cyclogenesis that extends from the Gulf coast of the United States northeastward to the Bay of Fundy. Other principal areas of cyclogenesis lie over the western half of the central ocean between Newfoundland and the British Isles, over most Icelandic coastal waters, over the inland waters east of the North Sea except the Gulf of Bothnia, and over the Mediterranean from the Gulf of Lions southeastward to the toe of Italy and then northward to the Yugoslavia coast. Cyclogenesis is more concentrated around the waters on both sides of central Italy than anywhere on the North Atlantic during winter with the exception of the band off the United States Atlantic coast. In January, primary storm tracks run from the Carolina capes to Cape Race and from Lake Superior to Cape Bauld. After reaching Newfoundland, cyclones either head northward to the Davis Strait or the Denmark Strait or northeastward to Iceland. Primary storm tracks are also present off the northern Norwegian coast, over the Mediterranean from the Gulf of Genoa to Cyprus, and over the eastern Great Lakes where they join the track toward Newfoundland.

SEA HEIGHTS greater than 12 ft occur 10 percent or more of the time north of 33°N over the western North Atlantic and north of 42°N over eastern waters. Frequencies greater than 10 percent also exist in a small area near Barranquilla, Colombia, and on the Mediterranean between Menorca and Sicily (not including the waters surrounding Corsica), south of Greece and west of Crete, and on the northern Aegean Sea. A large area of frequencies greater than 30 percent stretches from south of Iceland to west of Ireland to east of the Grand Banks and then northward to the waters southwest of Greenland and south of the waters between Greenland and Iceland. Smaller areas of similar frequency are found on the Denmark Strait and west of northern Norway near 67°N, 10°E. The frequency of sea heights greater than or equal to 12 ft decreases to less than 10 percent over a large portion of the Norwegian Sea north of 67°N between 5°E and about 13°W.

VISIBILITY less than 1 mi is noted in more than 10 percent of the observations from Cape Sable eastward to the Grand Banks and northward to Cape Mercy, over the Denmark Strait and the northwestern portion of the Norwegian Sea, and over the southern portion of the North Sea. The frequency increases to more than 20 percent in the Resolution Island area and over the Norwegian Sea north of about 70°N.

NORTH PACIFIC, JANUARY

WEATHER. The most severe weather of the year generally occurs in January over the middle and northern latitudes of the North Pacific. The circulation over the ocean is controlled mainly by the major centers of action--the Aleutian Low, the subtropical High, and the Siberian High. All except the subtropical High are near or at their peak seasonal development. The Aleutian Low, with a central pressure of 1000 mb, is southeast of Kamchatka near 50°N, 165°E, while the axis of the Pacific subtropical ridge exceeds 1021 mb from about 30°N, 135°W, east-northeastward to the State of Wyoming. The wind regime near the Asiatic coast from the Korea Peninsula to the South China Sea is controlled principally by the clockwise flow around the Siberian High (1036 mb), situated over Asia near 49°N, 96°E.

WINDS. Westerly winds prevail over much of the ocean north of 30°N and west of 180°. Northerly winds dominate the East China Sea. Winds are variable over the western Aleutians, southeasterly over

the central Aleutians, and northeasterly near the Pribilof Islands. From the Gulf of Alaska southward to near 40°N and east of 180°, winds are mostly westerly to southerly, although other directions are common during the frequent passage of LOWS. Over the extreme northern Gulf of Alaska, the prevailing winds are easterly, and northerly winds are very pronounced over the Bering Sea north of 60°N. The average speed of winds north of 30°N is force 4 to 6, although southeast of Kamchatka the wind blows at force 7, 21 percent of the time. The "northeast trades" extend northward to near 25°N over most of the western and central ocean and to 30°N over eastern waters; south of 20°N, these winds are very steady. The wind speeds in the trades range from force 3 to 5. The "northeast monsoon" is steady over the South China Sea and the Philippine Sea south of 30°N and west of 150°E. Winds are quite variable over the eastern North Pacific between 30° and 40°N, southwesterly over the east-central ocean between 25° and 40°N, and variable over west-central waters between 25° and 30°N and 150°E and 180°. Wind speeds over the above three areas are usually force 4. Northerly winds predominate over the Gulf of Tehuantepec, and in 65 percent of the observations they range between force 2 and 6.

GALES. The frequency of gales near and above 10 percent affects most noncoastal areas south of the Aleutians and north of a line from the waters southeast of Honshu to a point south of the Queen Charlotte Islands and west of Washington State. A maximum incidence of over 20 percent is found over a relatively large region southeast of Kamchatka, over a smaller area east of northern Honshu near 39°N, 154°E, and south of the Gulf of Alaska near 50°N, 145°W. Gale-force northerly winds are encountered more than 10 percent of the time by vessels plying the Gulf of Tehuantepec off southern Mexico. These violent squally winds occur when strong northers from the Gulf of Mexico funnel across the isthmus to the Pacific. In extreme cases, they may be felt more than 200 mi out at sea.

EXTRATROPICAL CYCLONES. Principal areas of cyclogenesis during winter are found from Taiwan on the southwest to the northern Kurils and lower Sakhalin on the northeast and from just north of Marcus Island on the southeast to the western shore of the Sea of Japan on the northwest. The Yellow Sea and Korean coastal waters are not included in this vast region of cyclogenesis. Other smaller areas of cyclogenesis lie over the Pribilof Islands, the Gulf of Alaska, off the North American coast from the Queen Charlotte Islands southward to northern California, and over the east-central ocean about midway between the Aleutian and the Hawaiian Islands. The migratory LOWS move mostly northeastward from the East China Sea and Hokkaido to the western Aleutians and then east-northeastward to the Gulf of Alaska. Other primary tracks approach the Gulf of Alaska and Vancouver Island from the southwest.

TROPICAL STORMS are infrequent in January. On the average, two can be expected every 5 yr over the western North Pacific. Most of these storms develop between 6° and 10°N and west of 150°E and move toward the southern half of the Philippines. Seven out of every 12 January tropical storms achieve typhoon strength.

SEA HEIGHTS greater than 12 ft occur more than 10 percent of the time in an area extending northward from 30° to 35°N to a line drawn from Kodiak Island to the central Aleutians and then to the southeastern waters of the Sea of Okhotsk, and westward from a line 700 mi off the coast of southeastern Alaska and 500 mi off the Oregon coast to 150°E.

VISIBILITY less than 2 mi occurs in 10 percent or more of the observations over an area of the eastern North Pacific between 40° and 50°N and 141° and 162°W, and northwest of a line drawn from Hokkaido to the western Aleutians and then northeastward along the Aleutian chain to the Alaska Peninsula and Cape Avinof. A maximum frequency of over 30 percent encloses a small area over the Okhotsk Basin southwest of Kamchatka.

NORTH ATLANTIC, FEBRUARY

WEATHER. Usually the weather over the North Atlantic during February is a continuation of the storminess characteristic of January, and there are years when February weather is the most severe of winter. The average pressure distribution remains quite similar to that of January. The Icelandic Low fills to 1004 mb, and the central pressure of the Azores High drops to 1021 mb near 32°N, 22°W. The 1020-mb Bermuda High lies near 27.5°N, 48.0°W. This reduction in the average north-south pressure gradient is caused both by LOWS being less intense on the average during February, and by the more frequent appearance toward the advent of spring of a blocking HIGH at higher latitudes.

WINDS. The prevailing wind pattern shows only a slight change from January. North of 40°N, the southerly winds over the North Sea have veered to westerly while the southerlies over the Norwegian Sea have become variable. Southerly winds are now found south of Iceland near 60°N, 20°W, and winds well west of the Bay of Biscay have become variable. Between 25° and 40°N, there is close agreement except that the southwesterly winds off the middle Atlantic coast of the United States are now northwesterly. Wind speeds are also nearly a carbon copy of those in January. The only exceptions are that between 25° and 40°N, the winds between 30° and 60°W have increased from about force 4 to force 4 to 6, and north of 40°N it is not as windy over the Baltic Sea.

GALES. The frequency of gales decreases near Iceland, the North Sea countries, the Mediterranean Sea, and the Baltic Sea. An increase in gale frequency is noted over the Davis Strait and the Bay of Biscay. The 30-percent frequency line vanishes over all areas previously encompassed by it during January. Lines of 20-percent frequency enclose these areas. Otherwise, the frequency of gales is about the same as in January.

EXTRATROPICAL CYCLONES. The only significant change in storm tracks this month is an increase in northeasterly tracks over the waters between the Grand Banks and 35°W.

SEA HEIGHTS. Seas 12 ft or higher can be expected

10 percent or more of the time north of a line from a couple of hundred miles east of Cape Hatteras to Cape Finisterre, Spain. On the Mediterranean, 10-percent frequencies lie inside an ellipse stretching from Barcelona, Spain, to Crete and then northwestward to Sicily, Sardinia, and the Gulf of Genoa. Another small area of 10-percent frequency lies between Crete and Turkey. The coast of Colombia still hosts a 10-percent line near the same area as in the previous month, but areas of 10-percent frequency no longer exist over the Baltic Sea or the Davis Strait. That portion of the Norwegian Sea with a frequency of sea heights greater than or equal to 12 ft of less than 10 percent extends farther south and west than it did in January. The highest frequencies, greater than 30 percent, are found over a triangular area between 57°N, 43°W; 45°N, 42°W; and 61°N, 13°W; and over the Denmark Strait.

VISIBILITY. The frequency of low visibility (less than 2 mi) reaches 10 percent or more from Halifax, Nova Scotia, northeastward to a point near 50°N, 40°W, and then northwestward to near Cape Mercy. It also reaches 10 percent on the southeastern North Sea and over the waters around the Faeroe Islands and eastern Iceland. The frequency increases to more than 20 percent inside a coastal region from Cape St. John, Newfoundland, to Resolution Island and then southward to Ungava Bay, and over the Norwegian Sea north of about 72°N.

NORTH PACIFIC, FEBRUARY

WEATHER. February weather in general is equally as rough as that of the preceding month over the middle and higher latitudes of the North Pacific. The average central pressure of the Aleutian Low (1000 mb) and the subtropical High (1021 mb) remains essentially the same as during January. The center of the Aleutian Low is displaced about 300 mi east of its January position, and the subtropical High (no longer an elongated ridge) is centered near 31°N, 138°W.

WINDS. The average direction and strength of the winds over the North Pacific during February conform closely to the mean January distribution. However, the winds over the central Aleutians have become more variable and the "northeast trades," although their average speed as a whole has lessened, are better established over the west-central ocean. The winds southeast of the Kamchatka Peninsula are not as strong either, reaching force 7 only 8 percent of the time. Over the Gulf of Tehuantepec, 71 percent of the winds are now force 2 to 6.

GALES. The areal distribution and percentage frequency of gales are also practically identical to the preceding month with a few exceptions. The 20-percent areas south of the Gulf of Alaska and east of northern Honshu increase in size. The other 20 percent area southeast of Kamchatka shrinks in size and moves farther southeastward to a position near 42°N, 173°E. Gales are not as numerous (less than 10 percent of all observations) over the waters south of the eastern Aleutians and the southwestern tip of the Alaska Peninsula and west of Washington State. The eastern extremity of the 10-percent line is west of Vancouver Island this month. Over the Gulf of Tehuantepec, gales are now reported in less than 10 percent of all observations.

EXTRATROPICAL CYCLONES. There is less of a concentration of storm tracks over Hokkaido and the southern Kurils in February than in January; secondary tracks converge 350 mi east-northeast of Hokkaido and head east-northeastward toward the Rat Islands in the western Aleutians. A primary track extends northeastward from the East China Sea to the waters south of the western Aleutians and then runs parallel to that island chain to the Gulf of Alaska. The passage of LOWS over the Gulf of Alaska along the track described above and the one entering from the southwest is more confined to the western portion than in the previous month. The storm path approaching Vancouver Island from the southwest does not contain a maximum concentration of individual cyclones until it reaches a point 500 mi from that island. In January, cyclones become concentrated along this path when 1,000 mi from Vancouver Island.

TROPICAL STORM activity is at the annual minimum during February. On the average, one can be expected every 4 yr over western waters. As in the other winter months, the principal region of cyclogenesis is east of the central and southern Philippines. Two out of every seven February tropical storms has reached typhoon intensity in the past.

SEA HEIGHTS. Seas of 12 ft or more are encountered from 10 to 20 percent of the time over most of the ocean area between latitudes 30° and 52°N from 140°W to 145°E. A small area with a similar frequency lies over the waters bounding Taiwan where the "northeast monsoon" blows strongly and steadily. Areas of 20- to 30-percent frequency extend between latitudes 44° and 49°N from 172°E to 153°E, and farther southeast 100 to 200 mi around a line drawn from 35°N, 165°E to 40°N, 175°W.

VISIBILITY. Areas of limited visibility (less than 2 mi) occur in more than 10 percent of the observations north of a line drawn from the Yellow Sea through the Sea of Japan, south of Hokkaido, and then east-northeastward to the Alaska Peninsula. A maximum frequency of over 30 percent surrounds the waters around Ostrov Paramushir, south-southwest of Kamchatka.

ADDRESSES OF NATIONAL WEATHER SERVICE MARINE CENTERS* AND PORT OFFICES

NOAA, National Weather Service Marine Centers have personnel who visit ships in port to check and calibrate barometers and other meteorological instruments. In addition, port meteorologists assist masters and mates with problems regarding weather observations, preparation of weather maps, and forecasts. Meteorological manuals, forms, and some instruments are also provided.

ATLANTIC AREA

National Weather Service Office, NOAA*
30 Rockefeller Plaza
New York, N.Y. 10020
212-971-5561

Atlantic Weather Project
National Weather Service, NOAA
U.S. Coast Guard Base
427 Commercial St.
Boston, Mass. 02109
617-227-8139

Atlantic Weather Project
National Weather Service, NOAA
General Post Office, Room 20
Norfolk, Va. 23510
703-627-7517

GULF AREA

National Weather Service Forecast Office, NOAA*
701 Loyola Ave.
New Orleans, La. 70113
504-525-4064

National Weather Service Office, NOAA
P.O. Box 4089
Houston, Tex. 77014
713-223-2777

GREAT LAKES AREA

National Weather Service Forecast Office, NOAA*
Cleveland Hopkins International Airport
Cleveland, Ohio 44135
216-267-0069

PACIFIC AREA

Port Meteorological Office
National Weather Service, NOAA
Room 728 Lake Union Building
1700 Westlake Ave., North
Seattle, WA 98109
206-442-5447

National Weather Service, NOAA
2544 Custom House
300 South Ferry St.
Terminal Island
San Pedro, Calif. 90731
213-831-9261, Ext. 539

National Weather Service Office, NOAA*
219A Custom House
San Francisco, Calif. 94111
415-556-2490

Marine Specialist
Operating Division
National Weather Service Pacific Region, NOAA
1149 Bethel St.
Honolulu, Hawaii 96811
808-546-5689

Marine Specialist
National Weather Service Office, NOAA
P.O. Box 2414
Cristobal, Canal Zone
3-1565

OTHER NATIONAL WEATHER SERVICE FACILITIES

The following NOAA National Weather Service Offices provide forecasts and climatological da... barometers may also be checked at these offices.

ATLANTIC AREA

National Weather Service Forecast Office, NOAA
Portland City Airport
Portland, Maine 04102
207-567-4670

National Weather Service Forecast Office, NOAA
East Boston, Mass. 02128
617-567-4670

National Weather Service Office, NOAA
T. F. Green Airport
Warwick, R.I. 02886
401-737-5100

National Weather Service Office, NOAA
Bridgeport Municipal Airport
Stratford, Conn. 06497
203-378-2344

National Weather Service Office, NOAA
National Aviation Facilities Experimental Center
Atlantic City, N.J. 08405
609-641-4325

National Weather Service Office, NOAA
Terminal Bldg., International Airport
Philadelphia, Pa. 19153
215-726-4275

National Weather Service Forecast Office, NOAA
FOB #4, Suitland
Washington, D.C. 20233
301-736-3070

National Weather Service Office, NOAA
Friendship International Airport
Baltimore, Md. 21240
301-761-5390

National Weather Service Office, NOAA
Washington National Airport
Washington, D.C. 20001
202-628-9149

National Weather Service Office, NOAA
Regional Airport
Norfolk, Va. 23518
703-853-3013

National Weather Service Office, NOAA
RFD #1, P.O. Box 50
Wilmington, N.C. 28401
919-762-3240

National Weather Service Office, NOAA
P.O. Box 10007
Charleston, S.C. 29411
803-744-3207

National Weather Service Office, NOAA
Imeson Airport
10101 Main St.
Jacksonville, Fla. 32218
904-353-6778

National Weather Service Office, NOAA
P.O. Box 2354, Airport Mail Facility
Miami, Fla. 33159
305-634-3915

GULF AREA

National Weather Service Office, NOAA
Tampa International Airport
Tampa, Fla. 33607
813-877-5244

National Weather Service Office, NOAA
FAA/National Weather Service Bldg.
215 Danley Drive, Page Park
Ft. Myers, Fla. 33901
813-936-2057

National Weather Service Office, NOAA
Municipal Airport
Pensacola, Fla. 32504
904-433-5407

National Weather Service Office, NOAA
P.O. Box 3, Bates Field Branch
Mobile, Ala. 36608
205-433-3581, Ext. 3241

National Weather Service Office, NOAA
P.O. Box 1026
Lake Charles, La. 70601
318-477-5214

National Weather Service Office, NOAA
P.O. Box 636
Nederland, Tex. 77627
713-722-7511

National Weather Service Office, NOAA
515 Post Office Bldg.
Galveston, Tex. 77550
713-765-9479

National Weather Service Office, NOAA
Rt. #2, Box 900, International Airport
Corpus Christi, Tex. 78408
512-882-3471

National Weather Service Office, NOAA
Brownsville, Tex. 78520
512-542-2428

National Weather Service Office, NOAA
Ryan Airport
Baton Rouge, La. 70807
504-388-3143

PACIFIC AREA

National Weather Service Forecast Office, NOAA
632 Sixth Avenue
Anchorage, Alaska 99501
272-9522

National Weather Service Office, NOAA
Box 590, Star Rt. #1
Juneau, Alaska 99801
586-3640

National Weather Service Office, NOAA
Rt. #1, Box 941
Warrenton, Oreg. 94146
503-861-2722

National Weather Service Forecast Office, NOAA
5420 N.E. Marine Drive
Portland, Oreg. 97218
503-236-3631

National Weather Service Office, NOAA
P.O. Box 1447
Eureka, Calif. 95501
707-442-2171

National Weather Service Forecast Office, NOAA
660 Price Avenue
Redwood City, Calif. 94063
415-364-0250

National Weather Service Office, NOAA
P.O. Box 2385
Oakland, Calif. 94614
415-568-0895

National Weather Service Forecast Office, NOAA
11102 Federal Bldg.
11000 Wilshire Blvd.
Los Angeles, Calif. 90024
213-824-7212

National Weather Service Office, NOAA
Lindbergh Field
2980 Pacific Highway
San Diego, Calif. 92101
714-293-5678

National Weather Service Forecast Office, NOAA
International Airport
P.O. Box 9428
Honolulu, Hawaii 96820
808-546-5542

National Weather Service Office, NOAA
Rt. #8
Agana, Guam, Mariana Islands 96910
55192

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
Environmental Data Service
WASHINGTON, D.C.

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE
210

Survivors--Watersoaked chickens peck around wreckage near Nausori, Viti Levu. The Fiji Islands were devastated by a rare October hurricane. For the story, see page 19. Honolulu Star-Bulletin photo by Arlene Lum.